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Annual Review and Forecast

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Composite telecom industry poised to spend $31 billion in 1984

DEL MYERS, EDITOR, and CZATDANA INAN, MARKET RESEARCH DIRECTOR

TELECOMMUNICATIONS equipment/construction expenditures for the restructured and composite telecommunications industry in 1984 are elusive and volatile figures. Estimates are plentiful but the data supporting them can be manipulated at its source or destination to match virtually any desired result.

The data which yielded TELEPHONY's estimate of $30.82 billion (see Table 1) mainly came from the major segments of the industry which have given us their best estimates. A few regulated companies did not supply information, claiming it to be proprietary, and competitive entities understandably withheld information that might aid and comfort the competition.

Also, any data collected during this tumultuous phase of telecommunications may contain a promotional factor that should but cannot be factored out.

Since the $31 billion figure exceeds the $29 billion estimate for 1983 (TELEPHONY, Jan. 10, 1983, p. 26), TELEPHONY's Research Dept. has challenged the data and compared apparent discrepancies with other research organizations, such as Northern Business Information, Inc., New York.

Most importantly, deregulation and divestiture have obscured or severed the historical track between this annual review and forecast and those of previous years. Attempting to backtrack is an exercise that ranges from frustrating to impossible.

Of the projected $30.82 billion expenditure, the regional Bell companies (RBCs) account for $13.919 billion; Independent telephone companies, $5.34 billion; long distance companies, $3.45 billion and business communications equipment for voice and data, $8.115 billion. (TELEPHONY's 1983 forecast did not include data communications. Therefore, the $3.6 billion estimate for data communications must be subtracted from the 1984 forecast in order to compare it with the 1983 forecast.)

The Independent telephone companies' forecast of $5.34 billion is close to the 1983 forecast of $5.1 billion and actual spending of $4.99 billion.

These figures, based on TELEPHONY's survey of the major Independents (see Tables 2 and 3), reflect a conservative attitude and tight management controls during this period of uncertainty over the source and size of future telecommunications revenue streams.

The five largest holding companies include only 22% of the Independent operating companies but they account for 87% of Independent revenues, 85% of Independent plant investment and 85% of Independent actual and projected spending during

Table 1. U.S. Telecommunications Construction Expenditures ($000,000 omitted)

	Independents	Regional Bell Companies	AT&T Communications *	Specialized Common Carriers	Business Customer Premises Equipment
1984	5,340	13,919	1,850	1,600	8,115**
1983	4,990	13,681	1,100	1,500	5,500
1982	4,825	15,604	1,200	800	n/a
1981	4,852	16,849	1,300	400	n/a
1980	4,544	16,354	n/a	n/a	n/a
1979	4,205	15,172	n/a	n/a	n/a
1978	3,471	13,172	n/a	n/a	n/a

** Includes $4.5 billion for voice communications equipment; $3.6 billion for data communications equipment.

* AT&T Communications was AT&T Long Lines prior to 1984

Cover art by Leon Dantlovics

Spending is up, but "comparability" is down in spending survey.

Table 2 Major Independents' Construction Expenditures and Other Statistics

	Total CO Switches (Actual)				% Digital				Total Equipped Lines (000 Omitted)				% In Service				Construction Expenditures ($000,000)			
	1984	1983	1982	1981	84	83	82	81	1984	1983	1982	1981	84	83	82	81	1984	1983	1982	1981
GTE	3,117	3,111	3,095	3,097	14%	9%	4%	3%	13,853	13,652	13,032	12,429	nr	nr	87%	90%	$2,833.0	$2,462.0	$2,772.0	$2,701.0
United	1,200	1,191	1,186	1,183	25	20	13	10	3,199	3,082	2,974	2,869	91%	90%	89	88	564.1	513.2	523.9	580.5
Continental	2,242	2,075	1,945	1,908	45	27	21	17	2,348	2,260	2,211	2,100	94	94	94	94	502.5	474.5	430.5	407.3
Centel	381	384	381	375	35	31	26	16	1,410	1,394	1,341	872	86	84	84	88	168.1	172.0	185.5	194.4
ALLTEL	537	537	523	520	24	19	15	10	933	921	906		86	85	84	85	145.0	145.5	148.4	125.5
Puerto Rico Tel	111	109	106	101	39%	29%	25%	15%	658	621	604	551	79%	79%	77%	81%	118.0	108.0	71.1	113.1
Rochester Tel	65	67	66	65	nr	nr	3	2	488	478	462	457	89	92	93	93	51.4	40.7	44.2	53.6
Century Tel Enterprises	179	149	145	142	10	9	8	6	238	237	237	230	85	83	82	81	40.0	31.0	34.4	28.6
Lincoln Tel	141	141	141	141	21	16	14	13	230	229	225	224	85	86	86	84	32.1	31.7	35.4	37.0
Telephone & Data Systems	175	172	164	163	20	11	7	1	191	187	174	162	84	84	83	83	26.5	31.0	36.1	24.5
Commonwealth Tel	76	76	76	76	33%	24%	22%	18%	170	165	160	155	86%	85	85%	85%	21.9	16.7	13.1	12.2
Pacific Telecom*	147	140	127	112	59	53	47	26	188	184	160	157	96	86	87	89	93.0	104.0	176.5	86.5
Anchorage Tel	11	11	11	10	50	42	33	27	156	148	124	118	76	72	77	73	27.5	30.1	39.1	22.6
Citizens Utilities	44	44	43	43	21	18	14	12	104	103	96	85	77	74	74	78	25.1	24.9	30.3	35.2
Illinois Consolidated	38	38	38	37	8	8	3	0	89	88	88	83	86	84	82	85	12.6	11.0	22.8	12.6
North State Tel	9	9	9	9	22%	11%	0%	0%	71	69	67	65	88	88	90	94	5.0	6.5	5.6	6.6
Concord Tel	nr	nr	nr	nr	11	0	0	0	71	70	69	67	86%	85%	84%	84%	5.5	2.3	2.7	5.9
North-West Tel	27	27	27	28	41	41	33	25	60	59	58	57	85	81	81	80	7.5	6.8	8.6	8.7
Universal Tel	57	60	58	58	11%	7%	5%	3%	47	46	44	41	90%	89%	87%	93%	5.6	6.0	8.4	11.2
North Pittsburgh Tel	9	9	9	9	33	0	0	0	40	40	39	39	85	84	83	80	6.0	5.5	5.4	nr
Denver & Ephrata Tel	6	6	6	6	37	0	0	0	38	34	33	33	81	86	85	83	6.0	3.0	2.1	2.4

*Includes Alascom, long distance carrier purchased in 1982

the 1981-1984 period of time (see Tables 2, 3 and 4).

These five companies also account for 74% of the 11,000 Independent central offices and 94% of the 21.7 million Independent access lines (see Tables 5 and 6).

The Independent telephone companies are replacing electromechanical switches with stored program controlled time division (digital) switches at a very rapid rate. At the end of 1981, 10% of the central offices in the 10 largest Independent companies had digital switches. By the

Table 3 Major Independents' Revenues and Other Statistics

	Total Revenues ($000,000)				Total Expenses ($000,000)				Plant Investment ($000,000)				Employes (Actual)	
	1984	1983	1982	1981	1984	1983	1982	1981	1984	1983	1982	1981	1983	1982
GTE	nr	nr	7,824.0	6,874.0	nr	nr	5,215.0	4,436.0	26,084.0	24,212.0	22,601.0	20,666.0	117,000	123,200
United	2,070.0	1,960.0	1,830.0	1,650.0	1,350.0	1,250.0	1,150.0	1,010.0	5,730.0	5,440.0	5,190.0	4,370.0	23,776	24,996
Continental	1,508.5	1,435.8	1,327.8	1,181.8	1,217.0	1,162.3	1,062.9	932.2	4,283.1	4,121.9	3,830.5	3,557.5	14,079	15,205
Centel	756.5	718.8	691.2	634.4	475.4	456.3	442.9	405.1	2,125.6	2,035.3	1,977.7	1,895.1	8,453	8,964
ALLTEL	493.5	449.9	399.2	346.9	353.1	322.7	305.4	263.3	1,708.0	1,594.9	1,478.1	1,358.4	5,507	5,618
Puerto Rico Tel	352.8	334.9	296.1	248.3	262.1	235.5	218.0	192.9	1,208.1	1,165	1,037.5	996.7	6,266	5,934
Rochester Tel	252.3	238.5	222.3	204.8	140.2	131.7	125.7	114.3	643.1	605.6	581.6	564.3	nr	2,491
Century Tel Enterprises	105.4	98.4	92.1	76.7	83.0	77.4	71.4	58.4	369.5	325.9	306.7	276.2	1,260	1,224
Lincoln Tel	127.2	121.1	116.0	109.0	85.7	83.4	79.0	69.1	371.4	350.4	336.0	320.6	1,784	1,926
Telephone & Data Systems	nr	nr	70.5	60.6	nr	nr	52.3	43.7	nr	nr	271.0	220.8	1,375	1,370
Commonwealth	nr	nr	56.9	50.9	nr	nr	32.2	30.4	nr	nr	203.4	195.1	nr	654
Pacific Telecom*	399.0	375.0	341.0	278.1	315.0	286.0	274.0	224.1	1,104.0	810.0	749.1	589.4	3,000	2,651
Anchorage Tel	105.8	103.5	85.5	71.7	72.3	64.7	61.4	56.7	185.8	174.0	156.7	132.1	805	798
Citizens Utilities	88.4	75.8	68.6	60.3	70.7	61.2	51.4	43.8	292.0	264.7	238.5	206.6	816	830
Illinois Consolidated	53.6	53.7	48.9	41.0	36.1	37.7	35.8	29.3	139.3	129.7	128.2	108.3	600	732
North State Tel	34.1	31.9	27.0	22.6	18.4	17.3	16.1	13.6	81.5	77.5	71.7	68.2	474	472
Concord Tel	23.5	21.6	20.1	19.5	13.8	13.3	12.8	12.0	69.0	65.0	61.7	58.9	337	337
North-West Tel	26.2	24.7	23.2	22.8	19.5	18.7	17.8	17.0	88.0	86.5	85.3	81.7	275	285
Universal	22.0	20.3	18.6	16.6	11.5	11.0	10.9	8.2	72.0	70.0	67.1	62.5	265	266
North Pittsburgh	22.5	21.7	18.2	15.4	19.5	17.5	14.4	13.4	57.2	55.3	53.4	51.7	nr	nr
Denver & Ephrata	15.5	13.2	10.6	9.2	8.0	6.8	5.5	4.7	15.5	13.2	10.6	9.2	137	125

Note: Puerto Rico Communications Authority and Virgin Islands Telephone Corp. though 19th & 24th, respectively in rank are not included

*Includes Alascom, long distance carrier purchased in 1982

end of 1984, this figure will increase to 26%, a substantial increase, because these 10 companies account for 80% of the Independent central offices.

This large increase in the deployment of digital switches is significant but should be seen in perspective: It is occurring in Independent territory with a total number of 21.7 million access lines, only 20% of the nation's 108 million access lines.

Digital switches are, of course, essential elements in the creation of an integrated digital network (IDN) which may become the long-awaited and much-discussed integrated services digital network (ISDN). However, digital switches currently are being installed for their favorable economics instead of future ISDN potential.

In 1983, the number of Independent companies decreased from 1400 to 1375, continuing a long-established trend. The rate of decrease is very slow, because the most economically attractive properties are not for sale or already have been acquired.

A more significant step in a new direction, though hardly a trend, is the merger of Mid-Continent Telephone Corp. and Allied Telephone Co. into a new entity, ALLTEL Corp. This new and larger company may fit more easily in a new telecommunications world dominated by giant holding companies—the RBCs, GTE, United Telecom and the like.

A tough job

Comparing the projected and actual expenditures of the Independents over the past several years is much easier than comparing AT&T's pre- and post-divestiture figures. Even the designation of the successor companies complicates the comparison because once-consolidated data now must be broken into many parts. Presenting it clearly is difficult and the presentations in this article are not cluttered with explanatory notes. Some data for the RBCs and AT&T anticipate their legal advent on Jan. 1, 1984; other data may treat the embedded customer premise equipment as the property of the RBCs although it also was transferred to AT&T Information Systems (AT&T-IS) on Jan. 1. Moreover, the Federal Communications Commission's Computer II decision almost completely barred the Bell operating companies from participation in the CPE market throughout 1983, a fact not mentioned in these data.

Most of the AT&T information for this review and forecast came from the company's "Information Statement and Prospectus," a document published in November 1983 to explain the divestiture plan. The document presents some of the information as if the divestiture had occurred June 30, 1983, and candidly states that "actual results achieved during the forecast period will vary from the

Continued on page 41

Table 4 Independent Telephone Company Composite Plant Statistics ($000,000 omitted)

	Station Apparatus	Station Connections	Large PBXs	Central Office Equipment	Buildings
1982	$3.234	$3.951	$977	$13.863	$2.330
1981	3.220	3.763	959	12.648	2.143
1980	3.102	3.428	928	11.420	2.024
1979	2.919	3.016	853	10.128	1.826
1978	2.536	2.606	726	8.964	1.644
1977	2.275	2.296	660	8.170	1.523
1976	2.058	2.032	599	7.543	1.439
3 Year Growth					
1979-1982	11%	31%	15%	37%	28%
1976-1979	42%	48%	42%	34%	27%

	Aerial Cable	Buried Cable	Underground Cable	Underground Conduit	Vehicles & Work Equipment
1982	$3.794	$5.961	$1.801	$1.054	$864
1981	3.493	5.401	1.594	947	804
1980	3.269	4.857	1.408	885	717
1979	2.979	4.166	1.245	766	641
1978	2.698	3.655	1.082	665	551
1977	2.516	3.219	976	607	460
1976	2.360	2.851	910	567	404
3 Year Growth					
1979-1982	27%	43%	45%	38%	35%
1976-1979	26%	46%	37%	35%	59%

	Gross Plant Investment	Operating Revenues	Number of Independent Operating Companies	Employes
1984	$50.000	$16.000	1.375	183.000
1983	45.555	15.222	1.400	186.000
1982	41.500	13.880	1.432	192.100
1981	38.298	12.206	1.459	197.200
1980	35.300	10.475	1.483	194.000
1979	31.664	9.240	1.488	190.000
1978	27.788	8.085	1.527	179.000
1977	25.130	7.115	1.566	167.000
1976	23.000	6.300	1.590	160.000
3 Year Growth				
1979-1982	31%	50%	-4%	-1%
1976-1979	37%	47%	-6%	19%

Table 5 Independent Telephone Company Access Lines and Central Office Statistics

	Access (Main) Lines			Central Offices by Service Type					
	In Service	Installed	Removed	SXS	XB	Analog	Digital	Other	Total Exch.
1982	21.672.219	4.401.701	4.183.053	67%	10%	5%	12%	6%	11.074
1981	21.428.802	4.031.152	3.506.617	70%	10%	5%	9%	6%	11.086
1980	20.808.167	4.406.063	3.333.026	73%	11%	4%	5%	7%	11.040
1979	20.078.325	4.237.567	3.400.400	75%	11%	4%	2%	8%	11.050
		17.076.483							
		-14.423.096	14.423.096						
	1.593.894	2.653.387							
Net Growth	8%	15% New							
		85% Replacement							

financial forecast, and that variations may be material. Because of extensive divestiture-related changes, forecast information lacks comparability with historical results."

This statement, necessary for the protection of investors, has a corollary in the data that spans the pre- and post-divestiture period: It, too, lacks comparability.

In 1984, for example, the RBCs' projected construction expenditure of $13.9 billion seems comparable to the reported expenditure of $13.8 billion in 1983 (see Tables 1 and 7). However, the total AT&T construction expenditure forecast for 1983 was $16.8 billion (TELEPHONY, Jan. 10, 1983, p. 26), a figure that

Table 6 Independent Telephone Company Installed Telephone Base (000 omitted)

	Total Telephones	%TT	Access Lines	Business Lines	Business Ext.	Resident Lines	Resident Ext.	PBX Extensions
1982	34,347	26%	21,672	2,870	2,800*	17,754	9,400*	2,4[illegible]*
1981	35,127	23	21,429	2,715	2,753	17,110	9,292	2,434
1980	34,527	22	20,808	2,747	2,680	16,182	9,089	2,379
1979	33,109	19	20,078	2,605	2,512	15,445	8,626	2,311
1978	31,472	16	19,246	2,321	2,327	15,801	8,083	2,180
1977	29,610	12	18,345	2,174	2,156	15,106	7,355	2,069
1976	28,123	9	17,538	2,025	2,002	14,619	6,749	2,017
3 Year Growth								
1979-1982	4%		8%	10%	11%	15%	9%	4%
1976-1979	18%		15%	29%	25%	2%	28%	15%

%TT—Percent of TouchTone instruments to total company-owned telephones.

Table 7 Regional Bell Companies Composite Plant Statistics and Construction Expenditures ($000,000 omitted)

Operating Revenues	Nynex	Bell Atlantic	BellSouth	Ameritech	Southwestern Bell	U S West	Pacific Telesis	Total
1984 Estimated $	9,825.2	8,323.1	9,799.1	8,344.0	7,754.9	7,436.8	8,082.1	$ 59,565.2
1983 12 Months/June 30	10,006.6	8,732.3	10,512.6	8,900.8	7,859.5	7,596.1	7,895.9	61,503.8
1982 Actual $	9,868.3	8,367.7	10,288.2	8,723.8	7,711.1	7,396.2	7,855.5	60,210.8
% Local Service	55%	50%	48%	56%	46%	43%	39%	
% Toll Service	43%	45%	49%	40%	49%	53%	58%	
1981 Actual $	8,641.4	7,500.3	9,206.3	8,070.5	6,782.4	6,789.0	6,818.9	53,808.8
% Local Service	54%	50%	46%	55%	45%	42%	38%	
% Toll Service	43%	45%	50%	44%	50%	53%	59%	
Operating Expenses								
1984 Estimated $	6,590.4	5,589.5	6,453.0	5,546.6	5,249.5	4,997.2	5,800.1	40,226.3
1983 12 Months/June 30	6,643.6	5,884.9	6,834.6	5,837.4	5,276.5	5,070.4	5,812.3	41,359.7
1982 Actual $	6,501.4	5,779.5	6,721.3	5,937.9	5,243.0	5,028.8	5,788.9	41,000.7
1981 Actual $	5,703.6	5,077.4	5,996.6	5,445.3	4,501.7	4,511.6	5,016.2	36,252.4
Operating Income								
1984 Estimated $	1,423.2	1,404.2	1,784.3	1,326.1	1,304.5	1,263.8	1,330.1	9,836.2
% Net	65%	68%	69%	70%	67%	70%	62%	
1983 12 Months/June 30	1,530.6	1,475.4	1,994.0	1,457.6	1,374.3	1,338.1	1,276.3	10,446.3
% Net	67%	71%	70%	71%	65%	68%	77%	
1982 Actual $	1,472.8	1,372.6	1,939.3	1,347.7	1,328.2	1,257.7	1,305.7	10,024.0
%Net	66%	68%	70%	69%	65%	67%	66%	
1981 Actual $	1,365.7	1,307.3	1,764.1	1,324.1	1,203.4	1,233.1	1,237.6	9,435.3
% Net	66%	64%	66%	64%	65%	66%	36%	
Telecom Plant Assets	15,186.3	14,596.3	19,081.6	14,409.5	14,112.0	13,767.8	14,493.8	105,647.3
% Total Assets	87%	90%	92%	89%	91%	91%	90%	
% Central Office Equipment	37%	44%	29%	33%	33%	33%	36%	
% Land & Buildings	9%	11%	9%	10%	9%	9%	7%	
% CPE wiring and equipment	15%	18%	13%	15%	13%	17%	14%	
% Connecting Lines	30%	27%	43%	37%	38%	32%	36%	
Construction Expenditures								
1984 Operating Groups	2,002.0	1,714.5	2,373.7	1,694.0	1,813.0	1,837.0	2,189.0	13,623.2
Cellular Mobile	21.0	28.9	31.9	49.0	17.0	80.0	68.0	295.8
1983	2,085.0	1,891.0	2,486.6	1,739.0	1,983.0	1,696.0	1,800.0	13,680.6
1982	2,158.3	2,094.7	2,749.8	1,757.0	2,295.0	2,113.0	2,436.0	15,603.8
1981	2,163.9	2,229.0	3,044.4	2,021.0	2,243.0	2,391.0	2,757.0	16,849.3
1980	1,979.4	2,213.6	3,152.5	2,093.0	2,217.0	2,244.0	2,455.0	16,354.5
1979	1,728.1	2,012.5	2,889.0	2,010.0	2,217.0	2,101.0	2,214.0	15,171.6
1978	1,460.7	1,671.3	2,612.5	1,822.0	1,943.0	1,910.0	1,752.0	13,171.5
Employes								
1984 Actual Number	98,200	80,000	99,100	79,000	74,700	75,000	82,000	588,000

Note: This table is based on the AT&T Information Statement and Prospectus, Nov. 8, 1983. This document treats the divestiture as though it had occurred on June 30, 1983.

Table 8 Regional Bell Companies Access Line and Telephone Statistics (000 omitted)

	Access Lines					Telephones		
	1983	1982	1981	1980	1979	1982	1981	1980
Nynex								
New York	8,300	8,211	8,210	8,071	7,926	10,390	11,678	11,871
New England	4,500	4,341	4,266	4,162	4,050	7,105	7,109	7,072
	12,800	12,552	12,476	12,233	11,976	17,495	18,787	18,943
Bell Atlantic								
New Jersey	3,973	3,844	3,758	3,660	3,542	6,546	6,619	6,554
Bell of Pennsylvania	4,495	4,474	4,445	4,379	4,288	7,633	7,950	7,964
C&P—District of Columbia	748	725	716	692	664	1,070	1,091	1,103
Maryland	2,178	2,107	2,070	2,029	1,959	3,514	3,605	3,563
Virginia	1,908	1,839	1,815	1,756	1,689	3,007	3,109	3,076
West Virginia	636	627	621	624	617	945	975	979
Diamond	309	303	297	287	276	531	540	534
	14,247	13,939	13,722	13,427	13,035	23,246	23,889	23,773
BellSouth								
South Central	6,211	6,079	6,008	5,869	5,737	10,388	13,034	10,573
Southern	7,380	7,155	6,921	6,725	6,431	12,672	10,674	12,697
	13,591	13,234	12,979	12,594	12,168	23,060	23,708	23,270
Ameritech								
Illinois	4,631	4,599	4,624	4,589	4,474	8,070	8,430	8,554
Indiana	1,384	1,373	1,378	1,366	1,345	2,482	2,618	2,664
Michigan	3,630	3,602	3,607	3,611	3,605	6,069	6,279	6,339
Ohio	2,893	2,882	2,883	2,868	2,833	4,756	5,001	5,071
Wisconsin	1,475	1,475	1,479	1,466	1,433	2,194	2,360	2,488
	14,013	13,931	13,971	13,900	13,690	23,571	24,688	25,076
Southwestern Bell								
Arkansas	625	609	606	601	586		1,016	1,033
Kansas	940	921	912	886	859		1,665	1,654
Missouri	1,780	1,757	1,750	1,731	1,705		3,069	3,072
Oklahoma	1,270	1,263	1,236	1,179	1,130		2,165	2,089
Texas	5,670	5,574	5,277	4,969	4,719		9,068	8,834
	10,285	10,124	9,781	9,366	8,999	16,903	16,983	16,682
U S West								
Mountain	4,757	4,656	4,718*	4,501*	4,278*	7,676	8,094	7,860
Northwestern	3,323	3,278	3,270	3,223	3,147	5,431	5,655	5,687
Pacific NW	2,488	2,453	2,450	2,402	2,318	3,616	3,863	3,935
	10,568	10,387	10,438	10,126	9,743	16,723	17,612	17,482
Pacific Telesis								
Pacific	10,715	10,409	10,275	9,926	9,533	15,071	16,372	16,157
Nevada	163	158	154	145	134		263	257
	10,878	10,567	10,429	10,071	9,667	15,071	16,635	16,414
	86,382	84,734	83,796	81,717	79,278	136,069	142,302	141,640
% +/− Previous Year	+2.0%	+1.1%	+2.5%	+3.1%		−4.4%	−.5%	

*Amounts for 1979-81 include El Paso County, Texas, operations sold to Southwestern Bell in 1982.

should be comparable to the 1984 combined forecast of the RBCs and AT&T Communications (formerly AT&T Long Lines)—a total of $15.8 billion. The reported spending of these two entities for 1983 is $14.8 billion.

An exact reconciliation of these figures probably would be less meaningful than carefully weighing them against this statement from the AT&T Information Statement and Prospectus: "The Bell System's total construction expenditures for tariffed telecommunications services for the nine months ended September 30, 1983 were $9.6 billion compared to $12.5 billion for the same nine months in 1982. These reduced expenditures reflect not only the three-week strike in August but also tight control of capital budgets and increased utilization of facilities already in place."

This statement should be taken at its face value: divestiture will not spark an AT&T or RBC spending spree. These new companies are positioning themselves for the long run, not a sprint. *How* they are structured and staffed and *where* they concentrate expenditures will be the most important signs of their endurance and prospects.

All of the former monopoly carriers know that the only telecommunications game in town lies in their former exclusive preserve. Although competition and innovation stimulate telecommunications consumption, only AT&T, the RBCs and the Independents are destined to lose market share.

This makes the composition and distribution of facilities such as switching centers, access lines, Centrex service, PBXs, key systems and the like of crucial importance to every entity. Therefore, this review and forecast includes Tables 8-10, which present statistics on access line terminations, business telephones and the like. These statistics reveal the substantial success of competitors in penetrating the former monopoly preserve: From January 1980 through September 1983, the net growth in PBX trunks was 43%. Only 44% of this net growth terminated in AT&T/RBC equipment while 56% terminated in customer-owned equipment.

Historically, the Bell System has replaced two existing business telephone systems for each completely new one installed. This "churn" in the embedded base cannot be counted as growth although it is an important factor in the mature U.S. telecommunications market. Approximately 15% of the embedded base PBXs will be replaced each year—a very attractive opportunity for competitors.

Seventy-two percent of RBC main lines terminate in residential telephones with customers owning 17% of them; AT&T-IS, 83%. Business telephones, key telephones and stand-alone key systems are the terminations for 16% of the main lines, of which only 17% terminate in customer owned equipment.

New ways

This "mass" telecommunications market will be served quite differently than it was in the days of the end-to-end monopoly service. Retail outlets progressively will take over the residential market as the customers begin to doubt the conventional wisdom of perpetually leasing low-cost telecommunications equipment like standard telephones.

Similarly, retailers, including small business equipment specialty stores, are handling communications equipment. Small, sophisticated systems

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Table 9 Regional Bell Companies' Business and Residential Statistics ($000,000 omitted)

Telco-owned telephones

	Total Telephones	Extensions Business	Centrex CO	Centrex CU	PBX	Residential
1982	136,069	8,212	6,265	1,027	10,410	40,494
1981	142,386	8,656	6,520	1,258	10,087	43,873
1980	141,674	8,707	6,439	1,480	9,642	44,070
1979	138,172	8,569	6,118	1,643	9,330	42,665
1978	133,346	8,256	5,635	1,772	9,232	40,709
1977	128,459	7,743	5,023	1,903	9,162	38,935
1976	123,131	7,340	4,410	1,935	9,292	36,454
3 Year Growth						
1979-1982	-2%	-4%	2%	-37%	12%	-5%
1976-1979	12%	16%	39%	-15%	-1%	17%

Telco-owned main lines and equivalent main lines terminating in telco-owned equipment

	Total Access Lines	Business Lines	Centrex CO Lines	Centrex CU Trunks	PBX Trunks	Residential Lines
1982	86,382	11,430	5,320	149	1,724	58,041
1981	84,734	11,709	5,441	152	1,612	60,283
1980	83,796	11,596	5,305	163	1,517	59,741
1979	81,717	11,273	4,985	175	1,454	58,574
1978	79,278	10,827	4,508	179	1,454	57,005
1977	76,303	10,396	3,975	195	1,437	55,298
1976	73,135	9,949	3,442	194	1,456	53,751
3 Year Growth						
1979-1982	6%	1%	7%	-15%	19%	-1%
1976-1979	9%	13%	45%	-10%	-1%	9%

Telco-owned main lines and equivalent main lines terminating in customer-owned equipment

	Business Lines	PBX Trunks	Residential Lines
1982	1,553	589	3,260
1981	1,058	454	677
1980	740	348	181
1979	521	272	69
1978	348	207	20
1977	220	163	14
1976	145	121	8
3 Year Growth			
1979-1982	198%	117%	4600%
1976-1979	259%	125%	763%

designed for the take-it-with-you, plug-it-in customer already are available.

The trend is clear: During the 1960-1970 period, the Bell System added two residential telephones for each access line added. By early 1982, the ratio was reversed: two telephones lost for each added line. Clearly, access lines now are the only accurate measure of telecommunications service with respect to population in the U.S. And, with the deregulation of CPE, its removal from the rate base, and the transfer of the embedded CPE base from the RBCs to AT&T-IS, tracking either residential or business access line terminations soon will be an impossible task.

The number of business access lines that are lost to bypass will be more difficult to detect unless there is a sudden mass exodus of large business users from the network. Neither competitors nor the telephone companies, however, need to count the access lines in order to identify potential bypass candidates: They are the highly visible large businesses, usually concentrated in small geographical areas.

The RBCs—or any telco—will not let them go without a fierce struggle. Indeed, the strategy of the RBCs already is clear: They will bypass their own local exchange company rather than lose a customer to alternate network providers. And the RBCs also intend to share in the CPE market that again opened to them on Jan. 1, 1984.

The strategy of the local exchange company also is clear: During 1983, most of the construction news described projects upgrading the capability of the local business loop plant. An appropriate mix of T-carrier and fiber optic technology is being extended to the relatively small number of business customers who require high-speed data communications. Competitors hoping to "cream skim" in this market face a more difficult task than did those who successfully penetrated the high-volume, long distance voice market.

Nynex, for example, has a large concentration of service firms in its territory—27 of the top 30 security firms, 6 of the Big 8 accounting firms, 12 of the top 50 life insurance companies and 13 of the 50 largest banks. New York Telephone derives 25% of its revenue from only 1% of its business customers. Nynex has an 800-person sales organization to make sure that its large business customers are not easy pickings for any competitor. The company will offer a range of proven and popular business communications equipment to large and small customers. And the company has stated that it will bypass its operating companies rather than lose revenues to competitors.

Other RBCs take the same stance. Southwestern Bell Corp. has 1250 wire centers in its network, 5 of which account for 10% of the company's data communications revenues. Ten percent of the centers account for 66% of this class of revenues—a powerful incentive to innovate and to deploy advanced technology to hold this base. The company has 70% of its lines served by electronic switches, compared with the RBC average of 55%. The company's five-state area contains 12% of the U.S. population and accounted for 26% of housing starts in 1983.

Bell Atlantic currently plans to concentrate its sales effort on equipment; Ameritech has announced a multi-million dollar program to upgrade Centrex to digital service, thereby reducing operating expense and the incentive for users to own their own equipment. U S West already has established a subsidiary to provide engineering, consulting, maintenance and installation services.

And officials of this company, too, have said, "We are beginning to bypass ourselves."

Pacific Telesis, in spite of well-

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publicized problems, has a unique territory: 1 in every 10 California homes has a personal computer, twice the national average. This company also has business customers concentrated in relatively small areas. Seventeen percent of them generate approximately 80% of its business toll calls.

BellSouth, located in the fastest growing section of the U.S., is positioned to grow with it. In its territory, population, personal income and new employment have grown at a rate substantially faster than the U.S. average rate. During the last 4 years, the combined assets of Southern Bell and South Central Bell have grown 47%; net income, 65%.

Jostling

As the RBCs reenter the CPE market through some type of subsidiary organization, they will be joining some 3000 firms competing for a share of the 1984 voice communications market estimated at $4.5 billion to $5.2 billion, and data communications market estimated at $3.6 billion.

In the voice communications area, manufacturers and interconnect companies will have a 50% share of the market; AT&T-IS, 29% and the RBCs, Independents and affiliated subsidiaries will share the remainder.

With such a mix of distribution channels, TELEPHONY arbitrarily has categorized them into six segments to avoid double counting and to facilitate referencing them:

- AT&T-IS—American Telephone & Telegraph Information Systems.
- RBCs—the regional Bell company subsidiary organizations.
- Independents—the marketing departments of Independent telephone companies.
- Independent subsidiaries—the structurally separate subsidiaries of Independent telephone companies.
- Manufacturers—the direct sales organizations or departments of manufacturers.
- Interconnect companies—the thousands of firms and dealers not structurally affiliated with any of the other distribution channels.

These distribution channel categories eliminate many sources of confusion but not all; for example, AT&T-IS is not the sole distribution channel for equipment manufactured by AT&T Technologies (formerly Western Electric). This assumption could be made since both companies belong to the same parent. Moreover, the term "interconnect" is inappropriate, because the conditions that once gave it meaning no longer exist.

Irrespective of distribution channel, the business communications marketplace is dominated by the products of a relatively few manufacturers: AT&T Technologies accounts for approximately 31% of the total PBX line shipments; Rolm, Northern Telecom and Mitel, 39%, and a host of competitors share the remainder of shipments.

TELEPHONY's 1984 survey of the business communications equipment supplier market concentrated on correlating the distribution channels with such data as customer base, average size of customer organization and type of equipment—a task that demanded the categorization previously described.

Manufacturer and Independent subsidiary customer bases mainly are firms having 50 or more employes;

Table 10 Regional Bell Companies' Line/Trunk Activity, Jan.-Sept., 1983

Installed	Removed	In Service 9/30/83		
8,330,061	11,782,595	51,482,483	**Residential**	Mains*
3,189,829	7,926,705	33,643,826		Extensions*
11,519,890	19,709,300	85,126,309		
47%	67%	59%		
1,770,836	2,027,587	11,039,658	**Business**	Mains*
862,274	1,353,467	7,663,159		Extensions*
2,633,110	3,381,054	18,702,817		
11%	12%	13%		
227,350	185,674	1,777,799	**PBX**	Trunks
889,832	1,317,125	9,960,752		Extensions*
1,117,182	1,502,799	11,738,551		
5%	5%	8%		
13,014	10,297	136,124	**Centrex CU**	Trunks
105,008	203,936	884,864		Extensions
118,022	214,233	1,020,988		
-1%	-1%	-1%		
995,679	999,163	5,305,968	**Centrex CO**	Lines
884,589	1,018,764	6,041,054		Extensions*
1,880,268	2,017,927	11,347,022		
8%	7%	8%		
1,327,586	594,321	3,162,984	**All Other Company-Owned Mains**	
5%	2%	2%		
5,904,356	2,038,371	12,996,408	**All Other CPE Mains**	
24%	7%	9%		
24,500,414	29,458,005	144,095,079	**Total Universe: Mains & Extensions**	
100%	100%	100%		

*Summed for AT&T annual report of total telephones

Table 11 Long Distance Revenues and Market Share

	Revenues ($000,000 Omitted)			Market Share		
	1983	1982	1981	1983	1982	1981
AT&T Communications	$23,500.0[3]	$21,404.0	$19,372.0	68%	70%	72%
Independents	8,300.0[3]	7,543.0	6,950.0	23%	25%	26%
				91%	95%	97%
MCI[2]	1,716.0	802.0	413.1			
GTE Sprint	620.0[3]	393.4	234.2	5%	3%	2%
ITT/USTS	200.0[3]	128.3	82.7			
U.S. Telephone	135.6	82.1	24.0			
Combined Network	146.1	34.6	1.8			
Satellite Business Systems	144.0	39.0	5.0			
Western Union/Metro-phone	50.0[3]	23.6	7.0			
	$34,811.7	$30,450.0	$27,089.9			

1. AT&T Communications (formerly AT&T Long Lines) figures are Bell System interstate revenues after payments to Independents.

2. MCI revenues are December-December, Form P 1981 & 1982, 1983 estimated. MCI fiscal year (March-March) revenues for 1981-1983 are $1,073 million, $506.4 million and $234.3 million, respectively.

3. Estimated by TELEPHONY.

Table 12 Fortune Companies' Headquarters Responsibility for Telecommunications Expenditures—1984-1985 ($000,000 omitted)

	1000 Industrials	300 Service Organizations	Median Average Anticipated Increase 1985 1000 Industrials	300 Service Organizations
Voice Communications				
Equipment	$3,376.2 24%	$1,160.0 20%		
Network Services	5,488.0 39%	2,196.0 38%	10%	10%
	$8,864.0	$3,356.2	10%	10%
Data Communications				
Equipment	$2,498.0 18%	$1,081.5 19%		
Network Services	2,753.0 19%	1,300.0 23%	10%	10%
	$5,251.0	$2,381.5	12%	10%

interconnect customer bases, smaller firms with 10-19 and 20-49 employes. Only 5% of the interconnect companies reported customer bases that include companies with 1-9 employes. This is a clear indication that these small establishments mainly are Centrex, key telephone or stand-alone key system customers—prime targets for interconnect sales.

Approximately half of the surveyed distribution channels are selling data communications equipment, mainly modems. Some reported that they also sell business and personal computers, printers and terminals. Manufacturers and Independent subsidiaries account for 64% of this group.

Approximately 15% of the survey questionnaires mailed to the interconnect companies were undeliverable in contrast to only 3% returned from the manufacturers and Independent subsidiaries. This undeliverable rate illustrates that competition is fierce and that the casualty rate of weaker firms is high.

Competition indeed is a sobering experience, as illustrated by the interconnect companies which lowered their 1983 prediction of a 40% to 60% increase in sales to a 1984 prediction of a 50% increase. Even this figure may contain a factor based on the hope that the Federal Communications Commission will kill Centrex service, thus forcing millions of small business users to obtain communications equipment from one of the distribution channels. Interconnect companies are pursuing this objective before the FCC through the North American Telephone Assn. (NATA). The powerful International Communications Assn. (ICA) opposes the NATA position.

Manufacturers and Independent subsidiary distribution channels expect to maintain their 1984 increase in sales at approximately the same median level as in 1983—29%.

The long distance communications companies' input for this review and forecast was brief and not always to the points desired (see Table 11). As competition for this huge and lucrative market intensifies, silence literally may be golden.

In 1983, total business communications expenditures were approximately $38.5 billion; in 1984, the amount will rise to an estimated $42.4 billion, of which the Fortune 1300 companies (1000 industrials and 300 service organizations) will account for $33.9 billion.

TELEPHONY's 1984 survey of the Fortune companies concentrated on quantifying the share of telecommunications expenditures directed by headquarters staff. The share is impressive—$19.9 billion of the total 1984 expenditure (see Table 12) will be controlled directly by the headquarters professional telecommunications staff. Under their control are approximately 60% of the Fortune company locations, the majority of which have 20 or more employes.

The question of whether or not large businesses will integrate voice and data communications responsibility now is moot: 53% of the industrial companies and 41% of the service organizations already have integrated departments (see Table 13.) And, if current plans are implemented, 73% of the industrial companies and 69% of the service organizations will have integrated voice-data communications departments by 1986.

Accompanying the departmental integration is the authority to integrate voice and data facilities; 53% of the industrial companies and 41% of the service organizations are considering purchase of integrated voice-data PBXs within the next 5 years and within a median range of 2 years.

A staggering 71% of the industrial companies and 60% of the service organizations are considering digital termination systems or other network alternatives, bypassing the local exchange telephone companies within the next 4 years but within a median range of 1 year!

Therefore, 1984 promises to be the telecommunications year that was!

The battle lines are drawn; objectives, clear; strategy, transparent. The contestants are in place and the struggle will be fierce.

Only those who are market wise, technically competent and financially strong will prevail. □

Table 13 Fortune Companies' Voice-Data Decisionmakers

	Voice Communications	Data Communications	Both Voice & Data Communications
Determine the Need			
Industrials	96%	53%	47%
Service Organizations	94%	47%	45%
Evaluate Equipment & Service			
Industrials	99%	71%	67%
Service Organizations	95%	62%	61%
Select Vendors			
Industrials	97%	59%	56%
Service Organizations	90%	50%	48%
Approve Purchases			
Industrials	63%	41%	38%
Service Organizations	59%	28%	27%
Not Involved			
Industrials	0%	4%	0%
Service Organizations	0%	5%	0%

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World telecom 1984 spending to level out at $78.8 billion

DEL MYERS, EDITOR, and CZATDANA INAN, DIRECTOR-MARKETING RESEARCH

TELEPHONY'S 1984 Annual Survey of International Telecommunications is the primary source of the information in this article. Supplementing the survey, however, is information obtained by TELEPHONY editors throughout the year from world telecommunications authorities. The survey, published in English, French and Spanish and sent to a selected sample of PTT administrations and operating companies, solicited information on planned spending and plant investment. More importantly, the information provided through the survey allows an accurate quantification of the world's existing telecommunications plant and its overall rate of growth. This information is much more valuable to the operating entity managers and planners, as well as their suppliers, than is the traditional measure of teledensity (the number of telephones versus population).

We deeply appreciate the continuing effort and cooperation of telecommunications authorities throughout the world in providing the information needed to reach this elusive goal.

And, as announced in TELEPHONY's 1983 survey report (Feb. 28, 1983, p. 39), all of the survey information is being made available to the International Telecommunication Union for use by its members. The report will be available to the public in June.–Editor.

THE 1984 world telecommunications spending estimate of $78.8 billion is like a stroboscopic view of a moving object—the action only appears to be stopped.

The estimate itself (Table 1) is based on a constant dollar, weighted extrapolation of data from 39 countries serving approximately 80% of the world's 565 million telephones.

Included in the estimate, however, is the 1984 United States estimate of $30.9 billion, a volatile figure that requires considerable interpretation (see TELEPHONY, Jan. 16, p. 34). The balance of the estimate, $47.9 billion, includes some unique international factors that also need interpretation. Estimates in United States dollars, for example, must be related to monetary exchange rates as well as inflation to prevent a distorted view. The degree of telecommunications liberalization and protectionism also introduces obscurity in the actual spending for customer premises equipment and the true market value of expenditures for equipment where an open market does not exist.

The net positive contribution of telecommunications investment to development never will be clear so long as the debate continues to pit the purely social (and, usually, desirable) dimensions of telecommunications policy against its economic or commercial dimensions. Too often, such elementary economic considerations as life-cycle costs, pay-back period and contribution to the gross national or local product are ignored. The absence of such data probably is the single strongest factor limiting telecommunications investment funds.

Other than the United States, the 1984 big spenders will be Japan, $7.3 billion (Yen 1.7 trillion); West Germany, $5.4 billion (DM14.8 billion); France, $3.9 billion (FF33 billion); Italy, $3.0 billion (Lire 5.0 trillion) and the United Kingdom, $3.0 billion (£2.1 billion).

Nevertheless, telecommunications spending in all the major countries except Italy is leveling out and growth rates are averaging approximately 5% annually; for example, Bell Canada's construction budget remained stable during the 1974-1980 period but, in 1982, the capital expenditure of $1.4 billion was less than the budgeted figure of $1.6 billion and identical to the 1981 budget figure of $1.4 billion. Bell Canada's actual spending figure for 1983 is not yet available but it probably will be $1.2 billion, 16% less than the budget projection.

Nippon Telegraph and Telephone

Continued on page 44

Table 1

World telecom spending: 1979-1984 ($000,000 omitted)

	International (U.S. excluded)		United States		Total World	
	Carriers	Open market	Carriers	Open market	Carriers	Open market
1984	$47.9	na	$22.8	$8.1[a]	$70.7	$8.1[a]
1983	48.7		21.3	5.5[b]	70.0	5.5[b]
1982	46.9		22.4	na	69.3	
1981	46.2		23.0		69.2	
1980	45.4		20.9		66.3	
1979	45.0		19.4		64.4	

a. $4.5 billion voice communications equipment and $3.6 billion data communications projected capital acquisitions by private business users.
b. Voice communications equipment capital acquisitions only.

Table 2

Western Europe: Business communications development[a]

	PBX systems				Year of public service			
	PBX systems	% Auto-matic	%-50 Lines	Modems	Telex	Facsimile	Teletex	Packet-Switched Data Network
Austria	9,500			16,500	21,900	nr	nr	1982
Belgium	50,258	100%	99%	nr	25,961	1983	1984	1982
Denmark								
Jydsk Telephone	12,200			nr	nr	nr	1983	nr
Finland								
PTT	5,734	99%	85%	6,681	7,765	1979	1982	1984
Association	20,455	100%	75%	20,455	PTT	1979	1982	1984
France	nr[b]			102,000	98,000	1980	1983	1978
Germany	767,550[c]	98%	96%	130,000	151,000	1979	1981	1980
Greece	14,300			nr	15,000	nr	nr	nr
Italy								
SIP	90,000[d]	90%	91%	106,426	58,000	nr	1984	1984
Netherlands	25,000			38,000	nr	1983	1984	nr
Norway	16,000			13,000	8,000	1981	1983	1983
Portugal								
TLP	15,000			1,300	nr	nr	nr	1984
Spain	32,680	84%	82%	54,436	28,000	1983	1982	1971
Sweden	41,730	94%	97%	49,737	16,900	1980	1982	1980
Switzerland	112,300	98%	nr	20,800	41,600	1979	1981	1981
United Kingdom								
British Telecom	nr[e]			82,000	92,000	nr	1983	1981

a. Figures as of January-December due to fiscal/calendar reporting.
b. DGT does not supply PBXs for rent or purchase. Northern Business Information (New York) figures show PBX installed base rose from 119,000 in January to 130,000 at the end of December. Key systems, which are privately and DGT supplied, rose from 304,000 to 327,000 and 148,000 to 160,000, respectively. TELEPHONY estimates 550,000 new lines installed annually, distributed Juemont-Schneider, 37%; CIT Alcatel of CGE, 30%; Thomson, 16%; and CGCT (former ITT subsidiary), 6%.
c. 93% of the reported total are under 25 line systems. Additional 225,000 key systems reported. Bundespost competes in PBX market, other major suppliers are Siemens, Telefonbau & Normalzeit, SEL, DeTeWe and Te Ka De.
d. Additional 500,000 key systems reported, averaging 2.5 lines per system.
e. Estimated 150,000 PBXs. No reliable estimate for key systems.
nr, no report.

Public Corp. (NTT) of Japan also has stabilized spending—in 1982, the latest year for which actual figures are available, spending was 0.5% less than the budgeted amount.

In the United States, the Independent telephone companies spent $5.0 billion in 1983 versus an estimate of $5.1 billion. American Telephone & Telegraph Co. (AT&T) exercised tight financial control over all its operations in the year before divestiture.

In 1983, the Bell operating companies or BOCs (now separated from AT&T), and AT&T Communications (formerly AT&T Long Lines) spent only $14.8 billion, 11.1% less than the budgeted amount of $16.8 billion.

Italy, in contrast to other major countries, is planning substantial growth. During the 1978-1982 period, expenditures amounted to $6.5 billion (Lire 10.5 trillion). For the 1983-1987 period, the projected figure is $15.5 billion (Lire 25 trillion).

Accurately comparing the 1984 world spending forecast of $79.8 billion with the $75.5 billion actually spent in 1983 requires some simple arithmetic—subtracting $3.6 billion from the 1984 forecast. This amount represents a data communications equipment estimate in the United States 1984 forecast. The 1983 forecast did not include a comparable figure.

The $75.5 billion actually spent in 1983 was $3.0 billion less than forecast with the United States accounting for $2.1 billion of the reduction.

Excluding data communications equipment, therefore, the adjusted 1984 forecast is $75.2 billion, $300 million less than the 1983 actual spending figure. Indeed, if many managers achieve their customary under-budget objectives in 1984, the actual spending will level out at approximately $75 billion.

Since annual expenditures in this range are approximately 16% of the world's total estimated $475 billion investment in telecommunications plant, is the world telecommunications industry only maintaining the status quo? Is real growth occurring? Where? Can this relatively flat annual spending for telecommunications be reconciled with the explosive telecommunications growth customarily predicted for the "information age"?

Answers to these questions mainly lie in the complex but interrelated areas of technology, economics, protectionism and liberalization/deregulation. The latter terms, although not interchangeable because of national legal differences, mean essentially the same thing: the elimination or curtailment of the monopoly role in supplying telecommunications equipment and services to customers and a corresponding establishment or expansion of the customer's role.

Technology and economics inexorably are forcing the issue of liberalization because technology leads to a much greater differentiation of demand and revenues among business users than among residential customers.

At the same time, technology offers alternate and economical ways to satisfy the demands and creates the climate in which alternate sources of supply demand the right to exist with or in place of the monopoly.

Business user groups such as the International Communications Assn. (ICA), the International Telecom-

Continued on page 46

Table 3

Access line, local network development & plant investment: 1982[a]

	Access Lines	Local Switches	% Distribution SxS	SB	ESS	Dig	Oth	Plant Investment (000 Omitted)
The Americas								
Telecom Canada								
Bell Canada	7,561,801	1,025	48%	36%	8%	8%		9,944,300
British Columbia	1,339,584	314	85		15			2,344,353
Alberta Gov't.	931,310	361	23	55	15	7		2,974,719
Manitoba	556,768	263	51	44	3	2		nr
Saskatchewan	487,066	375	41	57	1	1		1,214,919
Maritime	376,322	170	24	51	12	13		615,000
New Brunswick	262,000	110	56	37	5	2		423,654
Newfoundland	174,087	86	48	42	12	13		252,439
Bahamas								nr
Bahamas Tel	32,090	21	39	24		8	29%	12,369
Grand Bahama	8,730	2		50		50		55,770
Bermuda	32,600	5				100		165,242
Dominican Rep.	148,500	53	80		20			243,000
Jamaica	71,600	41	34	66				
Puerto Rico								1,037,527
Puerto Rico Tel	603,723	1133	1	53	23	18	5	nr
PR Comm Authority	53,000	30						209,500
Trinidad	56,800	32	66	11	23		-1	
Argentina	2,200,000	1,300	65	23	12			nr
PTT	2,200,000	1,300	65	23	12			nr
De Telefonos	211,550	60		51	14		35	139,800
Brazil	5,930,000	3,502						9,539,269
Chile	429,324	70	20	77		3		862,000
Colombia								
Medellin	303,600	36	19	72	6	3		97,370
Costa Rica	205,143	145		98			2	290,800
Mexico	3,034,044	893	8	72	20	-1		3,127,869
Panama	194,440	46	30	4	11	9		173,829
Peru	112,257	217	17	1	56		27	nr
Uruguay	262,000	36	82	8				nr
Venezuela	1,241,591	449						nr
United States								[b]
Bell Regionals	84,734,000	10,200	51	23	26	-1		117,386,000
Independents	21,672,000	11,000	67	10	5	12	6	41,500,000
Western Europe								
Austria	2,438,672	1,447						2,710,610
Belgium	3,106,158	553	11	25		64		2,182,300
Denmark								
Jydsk Tel	1,001,997	697	92	8	-1			nr
Copenhagen Tel	1,400,000							nr
Finland								
PTT	730,842	2,228	18	82		-1		1,700,000
Assoc.	1,673,303	1,504	39	56	4	-1		nr
France	20,683,534	9,089	-1	83	5	15		21,029,000
Germany	25,847,000	6,105	5		-1		95	23,340,000
Greece	2,400,000	3,711						nr
Italy	15,000,000	9,803						nr
Netherlands	5,900,000	1,380						nr
Norway	1,559,000	3,732	90	-1		10		2,225,800

munications User Group (INTUG) and the currently inactive Business Telecommunications Services in Australia (see story on p. 50) are the ultimately invincible vanguard of telecommunications liberalization.

The United States is the best (some say, worst) example of what happens when the trustworthy monopoly crumbles. Certainly, the United States is not the model that many PTTs willingly intend to follow.

"If we were crazy," France's telecommunications Director General Jacques Dondoux told TELEPHONY (April 25, 1983, p. 25), "we could say, let's be like the United States and have 20 telephone companies in the country. But I have never heard a suggestion that a U.S. Bell operating company be cut up in 20 pieces. . . .French telecommunications. . .[with] about 20 million main lines [and] 20 administrative regions is about the same order of magnitude as an American BOC."

". . .my personal determination," Dondoux said, "is to have adequate management within the framework of the regulated system to make sure the French do not wish to deregulate."

Paolo Benzoni, managing director of SIP, the Italian company responsi-

SWT	TRANS	TMW	MOB	SAT	CPV	CPD	UND	BUR	AER	SUB	COX
23%	11%	2%			14%	5%	10%	7%	11%	2%	
21	9	3	-1%	-1%	22	2	12	2	12	-1	
27	3		9		5	13	8	2	2		12%
20	5	10	2		12	2	5	22	4		3
21	7	12	2		14	3	4	5	16	-1	-1
22	11	6	5	1	3	2	5	2	17	1	
27	5	7	1		14	1	5	2	19		
18	1				40		16	4	12		
38					24		14	-1	6	-1	
37	2	3		3	6		9	-1	9	3	
30	7				24	-1	9	2	12		
31	10	2	-1		9	-1	10	5	10		-1
31	14				5	2	5		35		2
46	5				4		35	all	cable		
46	5				4		35	all	cable		
40					7		26		15		
39	15		1			39	all	cable			
44	2	2	11		12		9		13		
47					12	5	5		9		
25	6	3	1		4	3	1	12	15	2	12
28	7	2	-1	1	9[c]	13[d]	18	-1	3		
17	6	1	-1	-1	6	2	42	all	cable		
32	6	3	1	1	9	2		25	5	1	1

Table 3 continued on p. 48

ble for more than 75% of the country's telecommunications modernization program, told TELEPHONY (Sept. 26, 1983, p. 32) that "SIP is not against further steps toward liberalization, as long as this process, which is to some extent inevitable, is gradual and care is taken to avoid waste due to duplication of plant or services."

SIP's strategic objectives, according to Benzoni, are development of the basic (telephone) service to the telephone maturity level of the principal industrialized nations (approximately 40 telephones per 100 people), network evolution and the implementation of new services and telematics. "Setting up private networks to serve particular markets," Benzoni said, "could use public network equipment, thus safeguarding its uniqueness and the economy of its operation."

"The government [of the United Kingdom] wants the marketplace to play a much more significant role in telecommunications," said Sir George Jefferson, chairman of British Telecom in a recent exclusive TELEPHONY interview (Jan. 23, p. 24). ". . .Whether the government can ever get to the stage of total deregula-

Table 3. . .continued

	Access Lines	Local Switches	% Distribution SxS	SB	ESS	Dig	Oth	Plant Investment (000 Omitted)
Portugal								
TLP	834,540	79	34	66				nr
CCT	1,331,337	943	70	30				nr
Spain	9,080,220	3,245		94	1	-1	4	11,512,000
Sweden	6,072,000	6,099		99			1	
Switzerland	8,820,000	1,022	88	12				4,873,000
United Kingdom	21,258,000	6,315	66	9	23		2	7,500,000
Middle East, Africa, Oceania and Far East								
Bahrain	69,000	11	59	9	32			17,853,000
Kuwait	294,200	19	74	11	15			nr
Israel	1,039,900	125	65	21	2	2		nr
Saudi Arabia	984,744	165		2	98			nr
Syria	306,900	40	89			11		nr
South Africa	1,970,915	nr	99			1		nr
Australia	6,140,000	4,783	6	71	3		20	2,338,857
New Zealand	1,200,000	826						12,040,270
Philippines								nr
PLD	426,621	51	71	3	24		2	932,554
Singapore	950,000	25	1	50	48	1		575,460
Thailand	482,454	204		100				329,566
Hong Kong	1,749,247	56	68	2	30			679,500
Japan	41,500,000	6,500						41,356,000
Taiwan	4,071,680	481	5	81	14	-1		2,778,687

a. Figures are for periods January-December 1982 due to fiscal/calendar reporting.
b. After divestiture.
c. Voice and data communications customer premise equipment.
d. Underground and buried cable.
e. Underground, buried and aerial cable.
f. Outside plant: 2.6% trunk, 5.5% junction cable/duct, 17.8% local, 0.8% submarine and 1.3% coaxial cable.

tion and withdrawal from licensing is for the future to determine."

These statements from world telecommunications leaders are typical: Every administration and telephone company in "mature" telecommunications nations is responding in some way to pressures for liberalization.

Like beauty, however, the adequacy of the response may lie in the eye of the beholder. At Telecom 83 in Geneva, for example, a business user complained to TELEPHONY of PTT unresponsiveness and described the growing impatience of the business community with PTT attitudes that view "compliance with a request as the first step in turning the asylum over to the inmates."

Understanding the nature and the extent of liberalization trends is important because they affect the accuracy of world telecommunications spending estimates. Since the United States has deregulated new customer premise equipment, it now is supplied by competitors, some of which are separate subsidiaries or divisions of regulated common carriers. Other suppliers are manufacturers, distributors, retailers and the like. Therefore, the telecommunications spending figures of the carriers no longer account for substantial sums and none of the competitors has an incentive to reveal annual sales forecasts.

Similarly, PTTs and administrations which permit interconnection of privately owned equipment to the network do not include it in their annual spending estimates. PTT type-approval, however, is a powerful form of regulation that makes this policy less open than it appears and, in Europe, PTTs purchase 75% to 90% of all telecommunications equipment.

Nevertheless, a substantial part of the world telecommunications growth associated with the information age is taking place outside the traditional boundaries of the world's telecommunications monopolies. TELEPHONY's 1984 spending estimate includes an accurate forecast for business communications equipment made by the large business users in the United States and a composite view of business communications development in Western Europe (Table 2).

Similarly, the level of expenditures for public switched network equipment and the numerical growth of the installed base (Table 3) do not tell the whole story. Virtually every administration and telecommunications company in developed and developing countries alike is purchasing or planning to purchase only state of the art equipment: stored program controlled time division multiplex (digital) switching equipment, fiber optic and satellite transmission links, packet switching and related data communications equipment, hybrid voice and data equipment, and the like.

And virtually every administration and telecommunications company expects to realize some form of the integrated services digital network (ISDN) within several years. In the United Kingdom and West Germany, for example, ISDN trials or limited service are imminent. In the United States, pre-ISDN services providing extensive digital connectivity are a reality. And, New Zealand's unique topography and commercial development make an extensive ISDN possible within the near future (see story beginning on p. 60).

While enhancing network capacity and capability is possible in mature telecommunications countries, many of the world's developing countries remain on the threshold of telecommunications development.

The 55 African nations included in TELEPHONY's international survey have 7 million telephones, slightly more than 1% of the world's 565 million phones (Table 4). Of Africa's total, the Republic of South Africa accounts for 43% and Algeria, Egypt,

SWT*	TRANS	TMW	MOB	SAT	CPV	CPD	UND	BUR	AER	SUB	COX
29	8	1	-1	-1	-1	13	-1	33[e]			-1 3
41	6	Nil	-1	-1	7	2	28	all	cable[f]		
43	13			-1	13	8	21	all	cable		
27	3	6	2	-1	12	1	29	6	5		
42	5	2	-1	1	10	-1	14		8	2	
21	5	4	4	1	4	4	27		-1	6	
35	5	9	3	4	6	6			16		
52	6				6	1	22		1		
32	2	1		-1	5	-1	22		8	1	

SWT: all switches and related equipment (circuits, test equipment, etc.); TRANS: all transmission equipment (including carrier, line conditioning, etc.); TMV: all terrestrial microwave equipment (including multiplex, etc.); MOB: all inside and outside mobile telecom equipment; SAT: all satellite earth station equipment; CPV: all customer premises voice equipment; CPD: all customer premises data equipment; UND: underground cable and conduit; BUR: buried cable; AER: aerial cable; SUB: submarine cable; COX: coaxial cable.

Kenya, Libya, Morocco, Nigeria, Tunisia and Zimbabwe account for 80% of the remainder.

The least developed countries have approximately 500,000 telephones and, currently, plan to spend an average of $350 million annually during the period of 1983-2000, a total of $5.9 billion.

Africa's overall development plans emphasize rural telecommunications and the projected growth rate of 14% annually will result in only 1 telephone per 100 people by the year 2000. While teledensity may be an insufficient measure of telecommunications development in industrialized countries, it clearly measures telecommunications insufficiency elsewhere.

Developing nations potentially are a huge market but telecommunications is not necessarily the number one choice for the commitment of scarce development funds. Generally, they and the international lenders concentrate funds in such areas as agriculture, electrical power and transportation.

During the 1968-1981 period, for example, 80% of World Bank loans went to seven sectors, including telecommunications. The share allocated to telecommunications, however, was 5.4% in the 1969-1973

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Table 4

Africa: Least developed countries

1983 (Millions) Population	Country	Telephones Actual 1983	Telephones Planned 2000	1983-2000 US$ (millions) Investment
3.520	Benin	16.200	144.000	$143.0
0.940	Botswana	17.000	47.000	155.0
4.350	Burundi	4.400	23.000	40.0*
0.296	Cape Verde	1.700	20.000	118.0*
2.350	Cen. African Rep.	3.600	60.000	62.2*
4.830	Chad	2.500	30.000	366.0*
0.370	Comoros	1.800	12.000	87.0*
0.360	Djibouti	5.200	45.000	31.0*
0.370	Equatorial Guinea	1.100	9.000	65.0
33.700	Ethiopia	105.800	900.000	495.0
0.620	Gambia	3.900	29.000	46.0*
6.140	Guinea	20.100	384.000	80.0*
0.580	Guinea-Bissau	2.200	15.000	57.0
1.370	Lesotho	5.900	35.000	48.0
6.430	Malawi	37.000	66.000	301.0*
7.330	Mali	8.800	47.000	306.0
5.845	Niger	9.800	45.000	274.0*
5.110	Rwanda	4.600	30.000	40.0
0.100	Sao Tome & Principe	2.100	11.500	36.0*
3.500	Sierre Leone	16.000	25.000	90.0*
4.900	Somalia	7.900	74.000	220.0
20.280	Sudan	68.800	371.000	895.0*
18.600	Tanzania	101.000	658.000	600.0*
2.710	Togo	9.800	40.000	37.0
13.890	Uganda	62.100	682.000	920.0*
7.090	Upper Volta	11.300	70.000	373.0
155.581		530.600	3.872.500 +630%	$5.885.2

*Estimated by country's PTT, otherwise estimated by ITU

World telecommunications tariffs vary widely, U.K. firm reports

R.J. RAGGETT, EXECUTIVE EDITOR-INTERNATIONAL

British business users enjoy the cheapest international telephone and local telex services, and the second cheapest trunk and international telex services, but pay top prices for local telephone calls. Rates in the U.K. for local calls are double those in Italy.

These are among the findings of the latest international telecommunications cost survey conducted by National Utility Services (NUS) Ltd., Croydon, U.K., which compared telephone and telex costs in Canada, the United States, Italy, France, Belgium, the U.K. and Germany.

Table I

International telephone/telex cost comparison January 1984 vs. 1983 (Source: NUS Ltd.)

Country	U.K.	France	Belgium	Italy	Germany	Canada	U.S.
Inflation (annual rate)	4.5%	9.3%	7.2%	14.8%	2.6%	4.5%	3.5%
Telephone Local call							
1983	0.086	0.049	0.060	0.044	0.057	nil	0.056
1984	0.088	0.049	0.060	0.044	0.057	nil	0.056
Increase (%)	2.3%	nil	nil	nil	nil	nil	nil
Telephone Trunk Call							
1983	0.516	0.741	0.273	0.558	0.867	1.029	0.957
1984	0.528	0.741	0.273	0.843	0.867	1.080	0.957
Increase (%)	2.3%	nil	nil	51%	nil	4.95%	nil
Telephone International							
1983	1.62	3.557	4.368	4.283	5.534	3.393	3.238
1984	1.65	3.557	4.368	4.327	5.534	3.393	3.238
Increase (%)	1.8%	nil	nil	1.01%	nil	nil	nil
Telex Local call							
1983	0.075	0.211	0.182	0.176	0.301	0.305	0.732
1984	0.090	0.211	0.182	0.207	0.344	0.322	0.732
Increase (%)	20%	nil	nil	17.6%	14.2%	5.5%	nil
Telex International							
1983	1.80	1.976	2.949	2.616	2.490	3.817	3.125
1984	2.16	1.976	2.949	3.014	3.038	3.817	3.125
Increase (%)	20%	nil	nil	15.2%	22%	nil	nil

Notes

1. Prices as of Jan. 11, 1984 and 1983.
2. Prices expressed in pounds/pence sterling with exchange conversions based on Financial Times of Jan. 13, 1984.
3. Prices are all without value added tax.
4. All calls, telephone or telex, are of standard 3 minute duration.
5. Trunk calls costed over a standard distance of 200 miles.
6. International calls are between New York and European capital cities in the countries surveyed except Canada which are Toronto to London only.
7. In the U.K. and Italy, the only two countries surveyed where charges vary according to the time of day (standard/peak rates), an average of these rates has been used to simplify the comparisons.

British Telecom's charges showed a curious polarization in the year reviewed, said the report. Overall bills are low—some 33% less than France's and only half Germany's—but all telex charges went up 20% during the year, and local and trunk telephone call charges increased by 2.3% in 1983.

While Belgian prices remained static as compared with 1982-83, and kept their place low down on the NUS table, Italy's trunk charges soared by 51% and a total restructuring of Italian telephone and telex tariffs led to a 17.6% and a 15.2% rise in local and international telex tariffs, respectively.

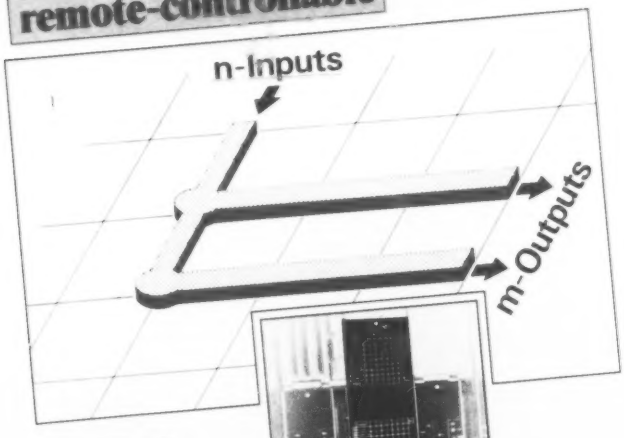
German telex costs rose substantially in 1983 and NUS anticipated a 30% rise in local charges in July 1984; these charges were last raised as long ago as 1973. German calls overseas remained the most expensive in the countries surveyed by NUS.

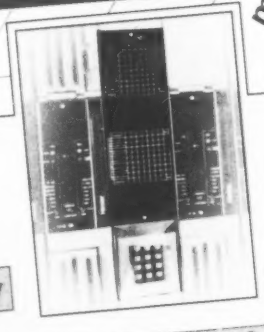
In the U.S., prices remained static in 1983. American Telephone & Telegraph Co. (AT&T) has filed to reduce trunk rates by 6% to 7% from April of this year, reflecting the competition offered by numerous alternative common carrier networks following the breakup of the Bell monopoly. AT&T has announced that the Federal Communications Commission's recent decision to postpone the imposition of access charges for at least 1 year "could prevent" the reductions in trunk rates (TELEPHONY, Jan. 30, p. 24).

Local call charges can be expected to rise, said the report, since the regional Bell operating companies can no longer be relied upon to subsidize local traffic from trunk call profits.

Canadian prices were either static or increased by the national retail price index figure. □

Microprocessor-controlled, remote-controllable





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period; 2.3%, 1974-1978; and 1.7%, 1979-1981. This decline in telecommunications funding is spectacular, especially since major supporters of the World Bank include the world's major telecommunications supplier nations: France, Germany, Japan, the United Kingdom and the United States.

The economic truth in this trend is, however, inescapable: Projects that can't withstand the trip to the bank don't get off the ground. Telecommunications either is not an essential infrastructure for development as widely claimed or telecommunications policy makers and officials are not making a convincing case for its contribution to the gross national and local product.

Costa Rica, which has a relatively stable economy, is a convincing example: During the 1973-1983 period, investment in rural telecommunications increased from 1% to 9% of the total budget, rural access increased from 28% to 36% of the total and business usage increased from 12.6% to 31.8% of the total number of calls.

TELEPHONY's 1984 world telecommunications spending forecast contains, therefore, more than a touch of contradiction: As developing countries struggle to extend telecommunications to their borders, the developed telecommunications supplier nations are locked in a different kind of struggle: Some of them want to contain telecommunications manufacture and control of service within their own borders while others are committed to an open scheme.

Virtually all telecommunications experts agree that few national markets alone are large enough to sustain a complete telecommunications manufacturing industry.

Therefore, the competition is intense and the weapons are not the clearly superior and more economical products of one supplier. In this area, current state of the art technology is a great equalizer!

The struggle centers on which national manufacturers will gain sufficient world market share to survive without subsidy and whether or not overt and covert telecommunications protectionism exacts too high a political and economic price to prevail as any nation's telecommunications policy.

In 1984 and beyond, this factor likely will emerge as the most powerful determinant of world telecommunications spending. □

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Exchange cost studies: an essential ingredient for telephone companies

STUART G. McDANIEL and WILLIAM WOHLHAGEN

THE RATE structure for local telephone service is changing.

Inclusive monthly flat rates set on a value of service basis are coming to an end. That inclusive rate used to cover unlimited local calling, a telephone set, directory assistance, repair service, inside wiring and an access line to the local central office. The rate was relatively low because local service costs were subsidized by other services.

Local flat rates were established under a value of service concept that set lower rates in small exchanges and higher rates in large exchanges. The concept served the industry well because it was easy to administer and received a high degree of regulatory and customer acceptance.

However, local rates had to be partially unbundled to accommodate the introduction of competition into the terminal equipment market, and in intrastate and interstate toll markets. Partial unbundling has been accomplished but most of the industry still operates with a local flat rate that continues to package in a single rate local usage and an access line to the central office. The monthly rate under the value service concept differs between exchanges according to the size of the calling area because of the assumed difference in relative cost and value.

Additional steps are necessary to complete the unbundling of local exchange rates that will produce a rate structure compatible with the operating environment that local exchange telcos will face. The past pricing practices of the industry and its regulators have, in large measure, brought about the competition which now exists.

If telephone rates historically had been set on the basis of the actual costs of providing services, the *status quo* may have been maintained because no potential competitor would have dared to enter the market given the economies of scale the telephone industry enjoyed.

Competition simply will not end with the terminal equipment and message toll markets. Prices set in a truly competitive environment will tend to equal or move in the direction of costs. To the extent future rate structures do not reflect actual costs, competition will increase.

'The past pricing practices of the industry and its regulators have, in large measure, brought about the competition which now exists. If telephone rates historically had been set on the basis of the actual costs of providing services, the status quo may have been maintained. . . .'

Lessons

Historically, most Independent telcos have derived their revenues from three principal sources: exchange services, toll services and vertical services. The situation in each of these markets has changed. Many Independents discovered that their prices for terminal equipment did not cover their costs when the contribu-

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Stuart G. McDaniel is Senior Vice President and *William Wohlhagen* is an Associate at Associated Utility Services, Inc., Moorestown, N.J.

tion from toll services diminished or vanished.

This situation developed largely when rates for terminal equipment were set without complete knowledge of what the actual costs of providing the equipment were. Frequently, such costs as inventory costs were ignored while other expenses were understated, particularly maintenance expenses. Some telcos have found that even in the new environment they simply cannot compete in the terminal equipment marketplace, either on a lease or sale basis, because their labor costs, including benefits, supervision and overhead, so far exceed those of the competitors that the telcos are better off financially if they abandon the business. Some telcos may totally restructure their terminal equipment business in order to provide it at a profit in case they must become a supplier of last resort.

Revenues derived from toll services, by whatever means the revenues are obtained, will likely continue to be an important source of revenues to telcos for many years. However, the contribution this source of revenues makes to the bottom line will undoubtedly erode as competition drives toll rates toward the marginal cost of providing service. It is not unusual to find companies receiving $1.50 per message of revenue through the settlements process, whereas the actual revenue generated by the company may be only $1.00. No viable provider of toll services could pay $1.50 in order to obtain $1.00 of revenue. As a result, the revenue contribution from this source probably will decline, particularly for those companies whose aggregate toll revenues greatly exceed billed revenues as a result of past settlements procedures.

What about the most basic service offered by telcos, exchange service? Telcos must price those services in such a way as to assure their continuing financial viability while continuing to provide universal service and minimizing the threat of bypass to the local network. Accomplishing these three goals simultaneously is a problem with the present rate structure.

'Revenues derived from toll services, by whatever means the revenues are obtained, will likely continue to be an important source of revenues to telcos for many years. However, the contribution this source of revenues makes to the bottom line will undoubtedly erode as competition drives toll rates toward the marginal cost of providing service.'

Basic exchange rates have been established largely by reference to the value of service concept. Traditionally, exchanges have been grouped according to the number of customers who could be called without incurring a toll charge. This method of pricing resulted in customers in larger exchanges paying higher rates than customers in smaller exchanges.

However, the evidence suggests that the cost of providing exchange service on a unit basis is higher in smaller communities and lower in larger communities. This situation is exactly the reverse of the situation currently reflected in rate structures based on the old value of service concept. Further unbundling is required to remove from the basic exchange rates local and EAS (extended area service) usage costs because access line costs are unrelated to, and vary independently, from usage costs. The access line cost/pricing problem is separate from the local and EAS usage cost/pricing problem, and it should be considered separately. The place to begin the restructuring process is with the most basic telco service, the access line. This would include the facilities necessary to provide dial tone at the customer's premise but not usage.

The access line, local and EAS usage must be priced separately and independently from each other.

The initial step is to discover the actual cost of providing an access line. Cost of service study procedures have been developed to identify access line costs for business, residence and trunks, as well as the costs of providing other services, including the costs of local and EAS usage, and toll service. While it may be informative to discover that, for example, it costs a telco $18 a month to provide a residential access line without regard to usage or toll subsidies, further analysis is required in order to convert that knowledge into an appropriate rate design based on costs.

One alternative, of course, would be to provide access lines at a uniform rate in all exchanges served by a given telco. Establishing an invariable access line rate by some criteria can be seen as a conscious decision to average costs company-wide. Is it the right decision for the future?

Access line rates which are averaged company-wide constitute a subsidy of high cost rural customers by low cost urban customers. This would further increase the incentive for urban customers to bypass the local network, especially for heavy toll users who already subsidize local costs through toll rates. Accordingly, further steps are required to provide more detailed cost information than most present cost of service studies now show.

Tariffs which propose setting

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'It must be recognized that the cost of service study will reveal the true cost of an access line without regard to any subsidies presently received from toll service or from any other source. The average cost per access line probably will greatly exceed the average rate because of subsidies still being received. . . .'

access line rates based on criteria other than the value of service exchange rate class schedules will require substantiation by cost of service studies which will identify access line costs on an exchange or grouping of exchange basis. Such access line cost data should be developed in order to support appropriate rate structures. The results of fully allocated cost of service studies indicate that the subscriber access line, defined as the local telephone loop without usage, represents the major cost in providing local service; it is typically 80% to 90% of the total cost when local and EAS usage is included. Moreover, the telcos which have the highest subscriber access line costs are the telcos which are more rural in nature.

Where should an analysis of exchange costs begin? Associated Utility Services, Inc., Moorestown, N.J., has developed fully allocated cost of service procedures to identify access line costs on a company-wide basis. These same cost of service procedures may be used to break down access line costs on an exchange basis.

For an initial study, it is a necessary step to observe differences in costs between exchanges in order to either establish rates on an exchange basis or to form a guide in grouping exchanges based on costs.

The difficulty is in defining the criteria for grouping exchanges. When access line costs are observed on an exchange-by-exchange basis and compared with where those exchanges fall within existing rate groups based on calling scope, significant disparities in costs for exchanges within existing rate groups are discovered. These disparities arise because some small exchanges may have significant EAS availability which puts them in a high rate group. However, access line costs exclude local and EAS usage; therefore, the use of existing rate groups based on calling scope form an inappropriate basis upon which to group exchanges based on actual costs.

Table I

	Company average	Density based rate group: Rural density	Suburban density	Urban density
Residence single party access line monthly cost	$18.00	$25.20	$19.80	$14.40
Ratio of exchange costs to company average cost	1.0	1.4	1.1	0.8
Proposed rate schedule	$10.00	$14.00	$11.00	$ 8.00
Present rate schedule	$10.00	$ 8.50	$10.00	$11.50

The difference in access line costs between exchanges can be more closely associated with the cost of providing the local loop or, stated another way, outside plant facilities. This fact suggests the conclusion that density of telephone development per square mile may be the most logical basis upon which to group exchanges for rate treatment since density greatly affects the cost of outside plant facilities on a per access line basis. While certainly not perfect by any means, this is a more appropriate basis upon which to group exchanges than the existing groupings based on calling scope which, in the final analysis, have nothing to do with total costs, including access line costs.

Adjustments may be required to reflect a particular company's individual circumstances. For instance, a company with a large number of multi-party access lines and a high degree of line fill may require weighting of the observed densities in order to place an exchange in the proper density group. Other criteria also could be employed, such as classifying exchanges on the basis of average local loop length. However, for most telcos, this information is not readily available; density estimates, on the other hand, can be readily obtained, tracked over time and allow rate reclassification based on change.

Having grouped exchanges on the basis of density, the average cost per access line for exchanges in each density group can be calculated. These costs then are compared to the company-wide average cost to develop ratios which can be used to redesign rates. It must be recognized that the cost of service study will reveal the true cost of an access line without regard to any subsidies received from toll service or from any other source. The average cost per access line probably will greatly exceed the average rate because of subsidies still being received, even by a company which is recovering its current revenue requirements.

Table I provides a simple illustration of the concept. In the table, monthly cost of providing a residential single-party access line is assumed to be $18. Moreover, exchanges have been grouped into three density bands: rural, suburban and urban. Exchanges in the rural density band have a monthly cost of $25.20 while exchanges in the urban density group have an average monthly cost of $14.40. A ratio of cost for each of the density bands with the company-side average has been computed. Finally, the table suggests what the present rate schedule based on value of service principles might look like. The proposed access line rate structure is, of course, precisely the opposite of the rate structure currently being used.

The rate schedule proposed in Table I when compared with the present rate schedule likely would not meet with overwhelming customer or regulatory acceptance, particularly in exchanges which fall within the rural density group. Therefore, it would be necessary to moderate the impact of such dramatic rate changes by using a phased procedure over a period of several rate cases. Nevertheless, the cost of service information developed on this basis certainly

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'When access line costs are observed on an exchange-by-exchange basis and compared with where those exchanges fall within existing rate groups based on calling scope, significant disparities in costs for exchanges within existing rate groups are discovered.'

provides a useful guide in determining the direction rates should move and provides a sound basis from which to defend such proposals before regulatory agencies.

Many telephone companies have two or more rate zones within an exchange. In the more densely populated areas, service is classified as being within the base rate area; service in those areas is priced lower than service in locations within the exchange but outside the base rate area. These rate differentials for individual line service may be several dollars per month. In the future, it is very probable that these extra charges will come under attack and cost justification will be requested. Access line cost studies will be helpful in addressing this question.

Finally, the cost of service study develops exchange and EAS usage costs separately from access line costs and, therefore, facilitates the development of a rate structure which prices these elements separately from access line prices. Of course, there are several ways in which usage may be priced. While justification may exist for studying local and EAS usage costs on an exchange-by-exchange basis, this is less important at this time because studies indicate that these costs do not vary from exchange to exchange as significantly as access line costs vary. Moreover, there appears to be no significant social pressure to subsidize local and EAS usage. □

'Access line rates which are averaged company-wide constitute a subsidy of high cost rural customers by low cost urban customers. This would further increase the incentive for urban customers to bypass the local network. . . .'

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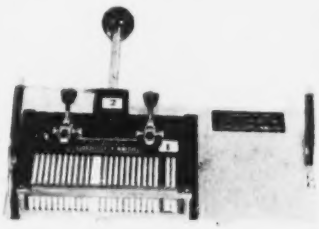

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Viewdata is maturing rapidly in Europe

JULIAN HEWETT

"*JE SUIS ici!*" announce the street posters in Paris, referring to the triumphant arrival of Teletel service in the French capital. The service is on public display in a bureau of cultural information that is appropriately located at the futuristic shopping complex of Les Halles.

Recently, I asked one of the Teletel terminal operators at Les Halles what concerts were planned for that evening. This request took about 10 minutes to process; the operator had to work her way through the cumbersome viewdata routing, before producing a hard copy of each relevant frame on the printer. However, I had previously acquired the same information from the newspaper in less than a minute! This personal experience helps to illustrate the answer to the question, "What is viewdata?"

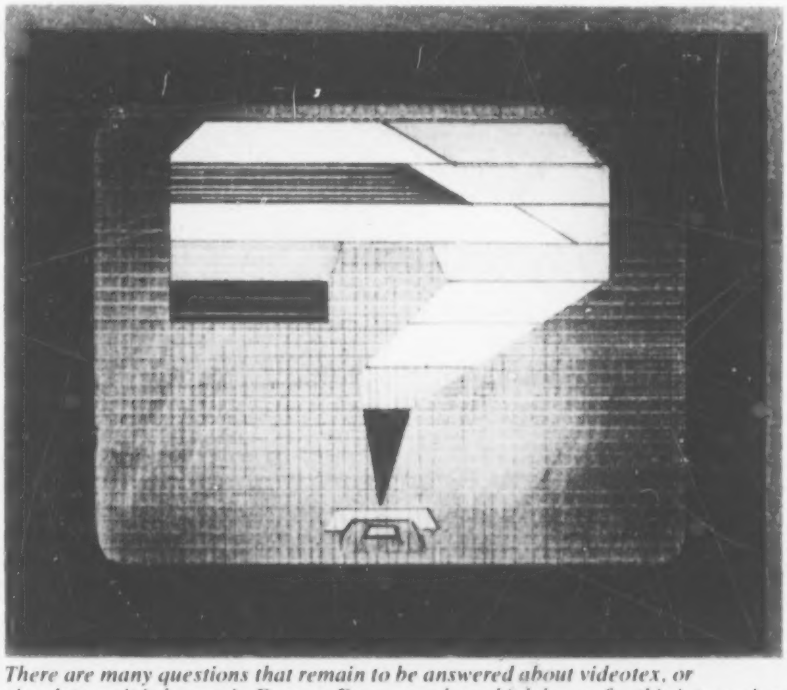
In essence, viewdata is only a presentation and transmission medium. In other words, it is a technology, not a product. It is the information that creates the market, not the medium. A great many potentially exciting viewdata applications have not proved successful because their proponents have failed to consider the competition, in other words, the alternative ways of obtaining the required information. A newspaper or a conventional phone call is often more convenient and usually cheaper. User friendliness and low cost—the two key features of viewdata—do not, by themselves, sell terminals. Thus, when measured against the original expectations around in the late 1970s, viewdata has failed.

The millions of Prestel sets forecast for British households by 1984 have not materialized. The original vision for Prestel was of a mass market service aimed at the residential sector, the main incentive of which was to increase utilization of the telephone network during the off-peak evening period. In fact, the results have proved to be completely the opposite. The main penetration of viewdata to date has been in the business sector which, of course, has used the medium during peak-rate business hours.

However, after having opened on a somewhat pessimistic note, it is worth pointing out that these earlier mistakes have succeeded in focusing the minds of those responsible for developing viewdata on the real issue: how can the viewdata medium best be exploited? This discussion will review developments in the major European countries before identifying the reasons, within both the residential and the business sectors, why viewdata is heading for explosive growth in the second half of this decade.

Public viewdata services

It is fascinating to review the approaches of the three major European countries toward public viewdata services in terms of how they relate to the national characteristics of the country in question. Viewdata was invented by the British, displaying their characteristic flair for innovation, but, equally in character, they completely failed to understand the market for Prestel, and it was unsuc-



Cover art by Leon Danilovics

There are many questions that remain to be answered about videotex, or viewdata as it is known in Europe. Europeans have high hopes for this interactive service which provides easy access to various databases. In the United States, the reactions are favorable, but more reserved.

Julian Hewett is a Senior Consultant with Logica U.K. Ltd., London.

Table 1

Status of public viewdata systems in Europe

Country	Name	Status	System	Current estimate of terminals
Austria	Bildschirmtext	Trial opened in March '81; full service opens in 1984.	GEC/Prestel	300
France	Télétel 3V	Trial opened in October '81; full service opened in October '82.	Télétel gateways and Transpac to hosts	10,000
	Electronic directory	Trial opened in 1982; full service available throughout France by 1986.	Télétel	40,000
Germany	Bildschirmtext	Trial opened in June '80; full service opens in 1984.	GEC/Prestel (trial) about to be replaced by IBM/CEPT	6000
Italy	Videotel	Trial opened in May '81; decision awaited on full service.	GEC/Prestel	1000
Netherlands	Viditel	Opened in 1980	GEC/Prestel	7000
Spain		Trial being conducted; full service opens late '84.	CTNE/CEPT	400
Sweden	Datavision	Opened in September '82.	Ericsson/Prestel	1000
Switzerland	Videotex	Trial opened in 1979; full service opened late '83.	DEC gateways and TELEPAC hosts	Not available
U.K.	Prestel	Opened in September 1979	GEC/Prestel	26,000

cessful in the residential sector. The Prestel system was purchased by the Germans, but right from the start they developed the idea of a gateway facility that would allow terminals to use the public system as a gateway to third-party databases on remote hosts. This development was heavily influenced by a German law, passed after the Second World War, that prohibits government bodies from broadcasting propaganda.

The French, on the other hand, developed the idea with a customary single-mindedness to ensure that their services would succeed at all costs. Basically, this consists of pumping large amounts of money into the development of services and terminal products. The intention behind this is to overcome the chicken and egg situation which has created problems elsewhere: information providers and terminal suppliers are reluctant to develop products until there is a worthwhile market; on the other hand, potential users are not keen to sign up until good databases and cheap terminals are available.

Prestel

Prestel, the world's first full operational viewdata service, was opened to subscribers in London in September 1979. Today more than 26,000 users can access 250,000 frames of information supplied by more than 1000 information providers. Prestel consists of a nationwide computer network which uses GEC 4082 computers. A large portion—60%—of telephone subscribers now have local call access to Prestel through these local Information Retrieval Centres (IRCs). There is an Update Centre (UDC) in London for information providers. Prestel has purchased Gateway software from the Deutsche Bundespost (DBP) and this facility has been available since 1982. Currently 70 third-party databases are available via Gateway. Prestel is now a mature service. Growth of subscribers had been sluggish until recently, when a number of marketing and product improvements have caused subscriptions to rise more rapidly.

Bildschirmtext

Bildschirmtext (or BTX) is currently at the end of a field trial in Germany. This began in June 1980 and is only available in the Dusseldorf-Neuss area and in West Berlin. The Bildschirmtext service has been the subject of much debate in Germany, particularly after International Business Machines Corp. (IBM) was given the initial contract for supply of the full service, an ambitious and complex network, in preference to German suppliers. IBM reputedly tendered a very low bid in order to win the contract because of its prestigious nature. However, IBM has missed delivery dates for the system and now is reported to be paying the penalties for late delivery. The complex network of IBM mainframes and Series/1 minicomputers will replace the GEC computers and Prestel software that the DBP purchased from the U.K. This new system will be broadly in accordance with the new CEPT (European conference of postal and telecommunications administrators) terminal standard, which is a European compromise between the existing British Prestel and French Antiope terminal standards. It remains to be seen how successful the new system will be, both technically and commercially, but the DBP has made a distinctly optimistic forecast of 1 million subscribers by 1987.

Télétel

The most far reaching services in Europe are being developed in France under the banner of Télétel. This currently includes two services:

a viewdata service and an electronic directory service. The Direction Generale des Télécommunications (DGT) began a trial viewdata service in three suburbs of Paris, known as Télétel 3V. This is currently being extended to the rest of the country. It is not the DGT's policy to provide services themselves but to encourage the development of services by others. It plans to achieve this via Télétel's distributed gateway architecture. This enables viewdata terminals to access a local Télétel node over the public switched telephone network. This node then switches the terminal through to the remote database of its choice. Communication between node and host is via Transpac, the successful French packet switched network. There are currently 200 host computers attached in this way. In addition, viewdata terminals have an auxiliary socket into which peripherals, such as facsimile terminals for hard copy, and a smart card reader, can be plugged.

The electronic directory service is intended to replace telephone directories. This is being achieved by the much publicized free distribution of Minitel terminals to any subscriber who wants one and who is within an area where the service is available. The service will be available nationwide by 1986; the DGT predicts that ultimately 80% of all telephone subscribers will opt for the service. The Minitel is a small black and white terminal mass produced in enormous quantities, thus keeping the unit cost extremely low.

In Austria, a Bildschirmtext trial opened in March 1981 with a full service planned to begin this year. Italy began its Videotel trial in May 1981 with about 1000 user terminals, but to date no decision has been made for the introduction of a full service. About 7000 terminals are in use in the Netherlands, which opened the Viditel service in 1980. About the same number of terminals are currently in service in Sweden, which began its Datavision service in September 1982. Switzerland's Videotex trial began in 1979, with a full service beginning at the end of last year. In Spain, the present trial system will be followed by a full service, scheduled to open toward the end of this year.

A summary of the nine major European public viewdata systems is in Table 1.

The residential sector

One of the major problems of marketing viewdata services into the residential sector is that three separate parties are involved in supplying the service: the service operator, the information provider and the terminal supplier. The other major hurdle is that the value of the service is simply not worth the substantial cost of a viewdata terminal or adapter. The key to success in the residential sector, therefore, is to overcome these two problems, and already there are indications that the French and British will achieve this.

The French electronic directory service overcomes both of these problems directly: the DGT is both the service operator, the information provider, and the terminal supplier; and the terminals are free.

As a result, there is little doubt that the French service will be tremendously successful. Obviously, this approach depends upon very substantial investment by the state and it is unlikely that this could be justified on a free enterprise basis. However, the socialist government of France clearly believes that this is the way to allow all segments of its population equal access to the benefits of computer databases and services. In addition, the French hope that a world lead in this area will prove to be a springboard for future exports, although to date their efforts in the United States have not been promising.

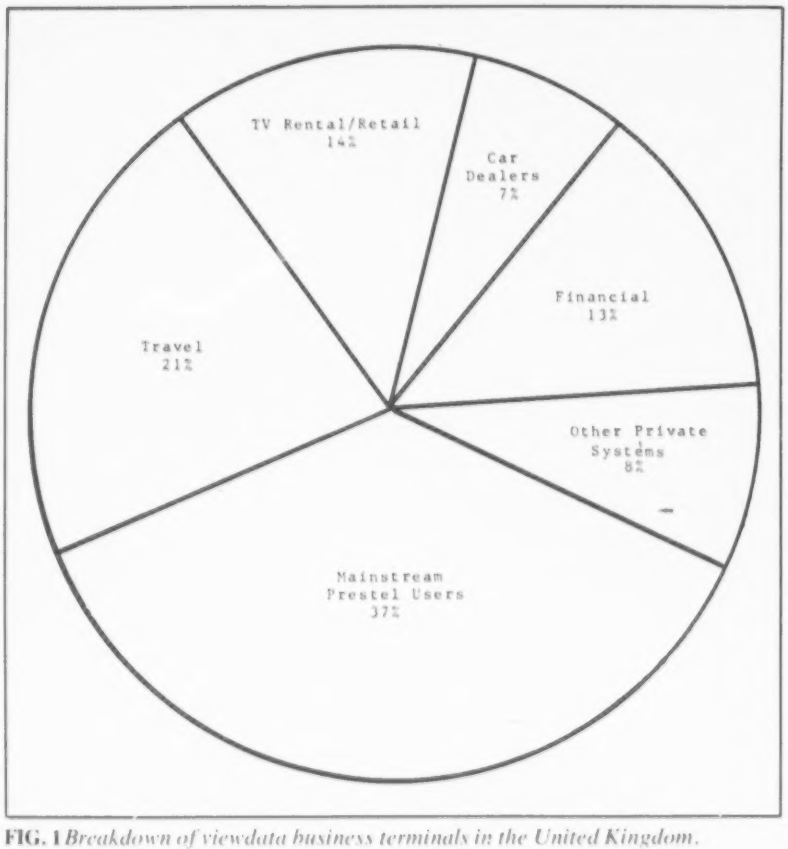


FIG. 1 *Breakdown of viewdata business terminals in the United Kingdom. (Source: Logica's Telematica Service, 1983.)*

The situation in the U.K. is completely different. Within the new environment of competition between telecommunications services, and the impending privatization of British Telecom (BT), the pressures on Prestel are to succeed without further subsidy. This has caused a considerable shift of emphasis in BT's approach to marketing. In the past, BT acted only as service provider and tended to rely on the television rental companies to market Prestel, with disastrous results. BT, therefore, has recently entered into several joint marketing agreements with information providers and terminal and adapter suppliers. The aim is to sell a self-contained service to a target market. These joint ventures, which have suddenly started a rapid increase in residential subscriptions, include:

- Club 403, a database developed by the Birmingham Post containing local news, information, advertising and home delivery services.
- Homelink, developed with the Nottingham Building Society, which offers customers home banking facili-

ties of a limited nature. To those customers who qualify for the service, the TV adapter comes free.

- Micronet, aimed at the home customer user, who is offered software via Prestel and a special adapter. This is reported to be extremely successful.

The business sector

The business sector makes use of both public (PTT operated) and private viewdata systems. In the short term it is the private systems that are experiencing the more rapid growth. Once again this is because private systems are installed for specific applications and, thus, are targeted at specific users. In addition, the most successful applications tend to use viewdata for transaction processing: in other words, as a cheap data processing system rather than as an information retrieval system, which was the original idea behind viewdata. The most exciting of these applications are those that are being introduced in industries where there is a "wholesaler" to "agent" type of relationship. These include:

- The travel sector, where agents access the databases and reservation systems of travel operators. The travel sector has been the major success story of Prestel, and viewdata (either via Prestel, Prestel Gateway, or directly to the operator's own private system) is now the standard means of communication between agent and operator in the U.K.
- The automobile sector, where car dealers locate and order cars using the stock control viewdata systems of their suppliers. British Leyland, Ford and Talbot are all using viewdata in this way.
- The insurance sector, where viewdata is considered to be an ideal medium for communication between insurance companies and their own branches, independent brokers and traveling salesmen. A number of trials are under way, and expectations are high in this sector.

Figure 1 shows an estimate of the breakdown of business viewdata terminals in the U.K. In the long term, however, public systems could well emerge as the more important systems in the business sector. Today, it is extremely difficult to justify a separate terminal for general access to a public service. But in the future, with the rapidly increasing populations of office workstations, access to public viewdata systems will be just one of a variety of office applications that these workstations will support. □

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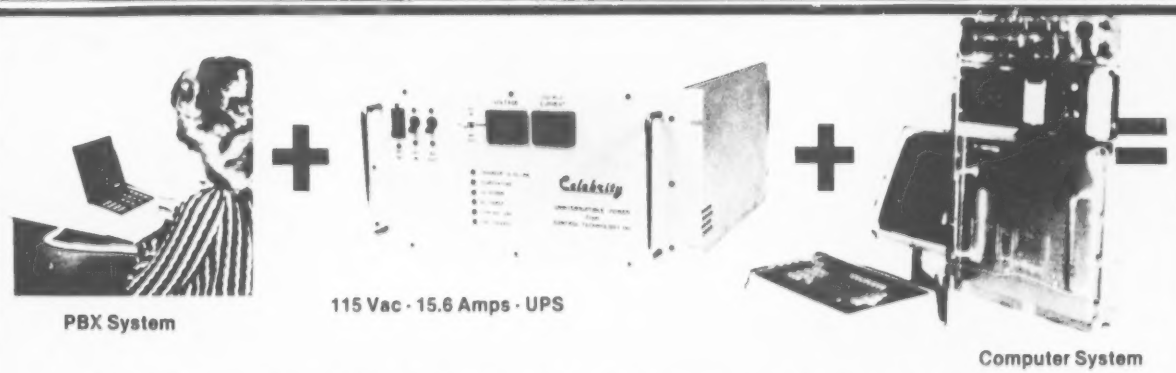

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Japan's telecom industry rushes into the information age

Thanks to careful planning and inter-company cooperation, Japanese telecom companies are expected to prosper in international and domestic markets

GENE GREGORY

IF TECHNOLOGY is the main engine of industrial and social change, the mounting wave of telecommunications innovations being introduced in Japan is destined to radically transform structures of economic activity and society as a whole during the remainder of the 20th Century.

The long awaited "information society" finally is emerging from the misty realm of dreams to tangible reality. The imminent privatization of Nippon Telegraph & Telephone Public Corp. (NTT), the launching of Japan's first operational communications satellite and the meteoric take-off of optical fiber production are signals which suggest the shape of things to come.

Changes now underway will have effects on human institutions and behavior as profound as the inventions of printing, the telegraph and the telephone. Office, factory and home already are being transformed.

The effects of new communications already are apparent in the restructuring of old industries and the calling forth of new ones. Japanese copper refiners, which depend on telecommunications for at least 12% of their total turnover, are confronted with declining orders as traditional wire cable is replaced by optical fibers in a widening range of applications. Cable manufacturers, of necessity, are diversifying from copper wire into glass fiber production, and a new sector of optical fiber component manufacturers is emerging. As communications equipment shifts from the analog to digital mode and as software is increasingly built into systems' firmware, large integrated electronics companies are gaining increasing shares of the market.

A new division of labor is developing among the major communications equipment manufacturers and smaller manufacturers gravitating into their orbits. At the same time, a new breed of software entrepreneurs whose services are required for advanced communications network design is shaking up established patterns of industrial organization, much as Sony, Casio and Pioneer did by spurring the earlier rise of the consumer electronics industry.

Societal commitment

Japanese communications and information industry policymakers have been specifically and wholly committed to the development of information technologies and their societal underpinnings for well over a decade. As a result, microelectronic, computer and consumer electronics firms, along with their labor unions and bankers, are prepared for the incipient communications revolution. Leadership in very large scale integration (VLSI) technology, fifth generation computer development and optical fiber technology—with special emphasis on mass production and application—place the combined Japanese electronics industry in an appropriate posture to take full advantage of the successive waves of opportunity in the new telecommunications age.

The nucleus of this national information industry complex is the so-called "Denden Family" of approximately 30 major telecommunications equipment suppliers subjected to NTT's rigorous performance specifications and quality standards. Of course, these same firms also have been the most direct beneficiaries of selective technological advances emanating from NTT's original three research laboratories, and by its newest research laboratory.

No less important, these designated suppliers have a substantial, ready market for the products developed jointly within the Denden Family. Although NTT accounts for a steadily declining share of the market for telecommunications equipment—approximately 33% in 1982—its Yen 2.5 trillion annual procurement provides suppliers with substantial relief from the risks inherent in technological change and assures them of important scale and experience economies that serve them well in other markets. In private and export markets, the high performance specifica-

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tions imposed by NTT also become important elements of competitive power.

Despite political pressures from the United States and the projected privatization of NTT, there are likely to be few major changes in these arrangements. The Denden Family derives its strength and reason for being from the inherent nature of telecommunications systems and technology. Their development requires close cooperation at all stages.

Uniformity and systems compatibility are imperative prerequisites of all technologies and equipment. Continuing communications made possible through a finely-tuned cooperative relationship cannot be replaced by arms length, *ad hoc* supply contracts.

There is nothing which requires that all members of the family be Japanese companies, of course, but in the past Japanese companies have been the equipment manufacturers—the logical partners in assuring operation of telecommunications systems.

The mutual obligations of family membership are likely to be even more important in the developing fifth communications age than in previous eras. Based largely on these arrangements, NTT has developed plans for the total overhaul of the telecommunications system during the 20 years from 1981 to 2000. This massive effort to develop a nationwide integrated information network system (INS) entails replacement of all existing cables with fiber optics, digitalization of networks, expansion of data and facsimile services, introduction of new video services, replacement of all existing telephones and other terminals, and the addition of a variety of new terminals for home, office and factory.

The INS will unify all networks through fully digitalized systems, replacing separate systems for different modes of communications: telephone, telegraph, telex, facsimile, data. At the same time, the new integrated system will be equipped with enhanced capabilities to assure projected changes in services:

- From mainly voice to video-intensive transmission.
- From principally man-to-man to more machine-to-machine communications in which computers and automatic remote control systems are active participants.
- To high speed and broadband transmission to accommodate increasing amounts of information.
- To add communications processing functions such as temporary storage, media or size conversion, translation and retrieval of messages as well as computations.

Total cost of this system's revision, in terms of direct capital outlays for equipment, is estimated at Yen 20 to Yen 30 trillion, plus Yen 1.3 trillion annual depreciation, over the 20-year plan period. In addition to these outlays by NTT, which surpass its outlays since it was founded in 1952, derived demand generated by this system—for local networks, exchanges and terminals—is estimated by Nomura Securities to be as high as Yen 60 to Yen 70 trillion.

Given the rapid pace of technological change in the telecommunications industry, however, these estimates could well prove to be conservative. One need only to think back to 1978 to understand the difficulties inherent in such forecasts.

Rand Corp. telecommunications experts in 1978 predicted that 64K microprocessors would be perfected in the early 1980s and reach integration densities in excess of 100K by the latter part of the decade. And they were right, in part. But the timing was off by several years, and by the end of the decade devices will be available with many times the capacity of those forecast. This more rapid pace in large scale integration (LSI) and VLSI technology, in turn, speeds the process of change in telecommunications technologies.

Optical fiber usage has been especially sensitive to the availability of more advanced LSI devices. Sales of optical fiber communications systems in Japan are outstripping earlier forecasts and demand continues to exceed supply even at current relatively high prices. From total sales valued at Yen 70 billion in fiscal year 1981, Daiwa Securities estimates that they will rise to Yen 700 billion in 1985, reaching at least Yen 7 trillion in 1990. Although Yamaichi Research Institute projects a slower growth in the 1980s than the forecast by Daiwa Securities, even this more conservative view of the future foresees optical fiber communications-related sales of Yen 12 trillion by the year 2000.

By the end of next year, NTT will have completed installation of the first trunk line using the large-scale optical fiber communications system that has been undergoing commercial tests since 1982. By 1990, according to plan, the entire nationwide grid, including individual subscriber lines, will be converted to optical fiber cable and the transpacific optical communications system will be operating between Japan and Hawaii.

Other interests

Telecommunications carriers are by no means the only market for optical fiber manufacturers, of course. Major Japanese electrical power companies have been perfecting their own optical communications systems for monitoring and controlling power grids. Since optical fiber is unaffected by the magnetic field of high-tension cables, Tokyo Electric Power Co. began research on optical communications in 1974 and perfected cable featuring tensile strength 25 times greater than its conventional nylon-coated counterpart, improved heat resistivity and other properties making it possible to combine optical fiber with suspension wire in a unified construction. This fiber-reinforced plastic (FRP) cable was developed with Sumitomo Electric Industries, Furukawa Electric, Fujikura Cable and Hitachi Cable; all four companies currently are producing it for domestic and foreign markets.

Optical fiber communications systems also are being developed for railways, subway systems and expressways. The most elaborate of these new transportation control installations is the integrated digital communications system adopted by the Tozai Line of the Sapporo Municipal Bureau of Transportation. Combining facilities for telephone and announcement services, operation control, power control and sales data processing, this integrated system is expected to serve as a model for other transport systems throughout the country. Major segments of the system have been developed by cooperation between leading firms in the field: Nippon Electric Co. (NEC) and Sumitomo Electric Industries have perfected data transmission systems; Matsushita Communications and Fujikura Cable, image transmission systems; and Fujitsu and Furukawa Electric, power control networks. Private and municipal railways have begun introducing surveillance and control systems employing various combinations of the new optical fiber technologies.

Similarly, optical fiber communications have been adopted by the Hanshin Expressway Public Corp., for monitoring traffic flow and highway communications facilities.

In broadcasting, Nippon Hoso Kyokai (NHK) and private operators

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are using optical fibers for their community antenna television (CATV) networks. NHK also is continuing research with Hitachi Cable to develop a multi-channel optical fiber system for very high frequency (VHF) telecasting. Videotex systems undergoing tests since 1979 have been based upon integrated optical fiber communications.

Other expanding uses of optical fibers include local area networks being established in commercial buildings, companies, universities and research institutes to meet the demand for multi-modal transmission, to link computers to peripherals and satellite earth stations to computer nodes. Manufacturers now are using optical fiber multiplex communications systems in cars, ships and elevators to control electrical equipment, engines and automatic systems.

To meet increasing demand, cable manufacturers have been doubling production annually, with the lead taken by the three firms—Sumitomo Electric Industries, Furukawa Electric and Fujikura Cable Works—which joined NTT in the cooperative research on the vapor phase axial disposition (VAD) method of optical fiber manufacturing. Because market demand has been running ahead of supply, NTT recently has decided to make its patents in this field available to three other large cable manufactures—Hitachi Cable, Dainichi-Nippon Cables and Showa Electric Wire & Cable—as well.

Although Hitachi Cable, Dainichi-Nippon Cables and Showa Electric Wire & Cable had developed their own optical fiber technology independently, the VAD method has proven to be most advantageous. Larger diameter cables and greater length are obtained in 10% of the production time needed for the most widely-used process, the modified chemical vapor disposition (MCVD) method developed by AT&T Bell Laboratories and Corning Glass in the United States. Hence, in the interest of uniformity and economics of production, NTT has licensed all major Japanese cable manufacturers with its technology.

As a result, at the outset of fiscal year 1983, optical fiber capacity rating of the big six cable manufacturers totaled 32,500 km monthly (see Table 1).

Both Nippon Sheet Glass and Mitsubishi, with their own production methods, also are producing smaller quantities of optical fibers.

Table 1

Manufacturer	Kilometers per /month
Sumitomo Electric Industries	10,000
Furukawa Electric	8,000
Fujikura Cable Works	8,000
Hitachi Cable	3,000
Dainichi-Nippon Cables	2,000
Showa Electric Wire & Cable	1,500
Total	32,500

Three distinguishing features mark the booming Japanese optical fiber industry. First, compared with other national optical fiber industries, the Japanese industry is much less concentrated. In fact, there are as many major optical fiber manufacturers in Japan as in the United States and Europe combined.

Second, each of the Japanese optical cable manufacturers have joined with communications and optical equipment manufacturers of their respective *keiretsu* (industrial or banking groups) in the development of optical fiber production, applications and marketing:

- Sumitomo Electric Industries is linked with NEC and Nippon Sheet Glass, all key Sumitomo Group companies.
- Furukawa Electric has close ties with Fujitsu, since both are members of the Furukawa and Dai-Ichi Kangyo Group.
- Fujikura Cable Works with Toshiba Corp. and Showa Electric Wire & Cable. Toshiba and Fujikura both have Mitsui Group connections.
- Hitachi Cable is a subsidiary of Hitachi, Ltd., and both have common links to the Sanwa Group.
- Dainichi-Nippon Cables, with strong Mitsubishi Group ties, works with Mitsubishi Electric.

These linkages not only assure the necessary financial resources for rapid development of optical fiber production, but also serve to speed the process of optical fiber technology diffusion throughout group companies which embrace many of the main fields of application.

Third, the technological commitment and strength of this basic industry of the information age is formidable. The top three optical fiber manufacturers have acquired MCVD licenses from Corning Glass and pioneered the development, along with NTT, of the VAD method. The other five producers all developed their own technology, and three of these have also been licensed to use the NTT's VAD process.

In fact, Hitachi Cable has developed two optical fiber production methods of its own. One of them, the soot deposition method, is similar to the VAD process and has almost all of the latter's advantages over the MCVD method. In addition, however, Hitachi Cable has jointly developed a single polarization monomode (SPM) fiber with Hitachi, Ltd., which permits light to travel straight down the axis of the fiber, reaching its destination before light which bounces down the cable, which is the usual method.

While tests on its wider application still are being conducted, this new fiber has found many non-communications applications in high precision optical fiber gyroscopes, blood flow meters, interferometers, magnetic or electric field measurement as well as connections between circuits. SPM-type communications using very high quality optical fiber measuring 10 microns or less in diameter are envisaged by NTT in a new public telephone service to be inaugurated in 1987 or 1988.

By then the impact of optical fiber communications already will be far reaching. Per channel costs of glass fiber transmission will be only a fraction of existing tariffs. Since higher information carrying capabilities make make possible transmission of all communications modes on the same circuit, costs will be further reduced through their integration.

Other developments

Lower service costs, broader transmission capabilities and the speed of communications also will be enhanced by improvements in microwave communications, satellite services and digital switching systems. Japan's first commercial communications satellite, Sakura 2, which went

into service last June with 4000 telephone circuits, will be joined by a second satellite in 1987 carrying 6000 circuits and more advanced craft in the 1990s with as many as 200,000 circuits. Although limited to back-up emergency services at the outset, satellite transmission will be used as relay transmission lines working in conjunction with optical fiber cable systems on the ground to form a highly reliable dual network.

In addition to these communications carrier satellites, broadcasting satellites will provide improved services for existing public and private networks, as well as new cable television systems. A group of three companies—Marubeni Corp., the Chunichi Shimbun and Uny Co., (respectively, a trading company, a leading newspaper and a major supermarket chain)—are preparing to launch a combined pay and free cable television service for the Nagoya region using a communications satellite in 1985. By 1988, the third Japanese broadcasting satellite, the BS3, will be launched, joining the BS2.

More diversified communications services at lower costs are being matched by similar developments in terminals made possible through application of successive generations of LSI circuits and more advanced VLSI circuits. The result is a boom in telecommunications terminals for offices and homes which will gain momentum after 1985 when the INS becomes operational. New high definition television receivers with flat screens and multiple functions which will be fully digitalized, will replace existing models.

Data communications services will give added impetus to personal computer usage, speeding the convergence of television with computer terminals. All existing telephones and switchboards will be converted to digital models. Developments in mobile communications are opening new markets for automobile radio telephones, cordless telephones and, ultimately, fully portable telephones. That powerful sleeping giant, facsimile communications, finally is awakening to an era of general office and home usage.

Although the take-off of new television services and digital receivers is still a few years off, car telephone services, begun in 1979, had been extended to approximately 200 cities with more than 20,000 subscribers by mid-1983. More economical base station equipment and a compact, low cost mobile radio put into commercial use in 1982-83 are expected to give a new boost to domestic demand. Meanwhile, leading Japanese firms, especially NEC and Matsushita Communications Industrial, are preparing for the huge United States market, where 1 million to 1.5 million mobile units are expected to be installed in automobiles during the next 10 years. The Middle East and Western Europe also are focal points of Japanese export interest. Matsushita Communications already has established its position in the car telephone market of the United Arab Emirates and Kuwait, and Mitsubishi Electric has begun exports to Western Europe, with initial exports going to the promising Swedish market.

Portable radio promises to be an even brighter star in tomorrow's communications firmament. As many as 20 Japanese manufacturers are already in the market, which industry analysts estimate will be worth Yen 2.2 trillion annually by the end of the decade. A rush for portable, high performance radio sets was triggered by the Ministry of Posts and Telecommunications' action in 1983 to rewrite the national Telecommunications Law, giving increased access to radio waves by private citizens.

This growth in mobile communications has been overshadowed by burgeoning facsimile equipment sales. While new models were improved in both efficiency and quality, prices dropped precipitously during 1982 as a result of increasing miniaturization and the introduction of advanced microelectronic devices. The response was electrifying. Unit sales rose 77% in 1982, producing a 30% increase in sales revenues.

Output of facsimile equipment in fiscal year 1983 was expected to reach 350,000 sets, which would mean a total turnover for the industry of approximately Yen 180 billion. But estimates of future growth vary widely. The conservative forecasts of the Communications Industry Assn. of Japan (CIAJ), predicting output of Yen 257 billion in 1985, have been scrapped. A more sanguine view, held by EDP Japan Report, estimates 1985 output at Yen 300 billion, rising to Yen 350 billion in 1986.

Evidence supporting the more optimistic outlook is convincing. The current boom in NTT mini-fax rentals, which has gained momentum steadily since introduction of the service in September 1981, will be further fueled in 1984 when Denden launches the new economical and compact Mini-fax 2 capable of transmitting an A4 copy within 3 minutes. By 1986, all major cities in Japan will be included in the public facsimile network, which then will be integrated with other communications networks in a single digitalized optical fiber system scheduled to be fully operational by 1990.

More than 25 companies are racing to develop new, high speed units, dual purpose fax-copying machines and combinations of fax with word processors, microfilm and optical character reading equipment, which are all calculated to increase the attractiveness of facsimile services to users.

With these and other improvements in the offing, the number of facsimile installations is expected to increase from 300,000 at the end of 1982 to 10 million in 1990. Since this estimate is based on an 80% saturation of the office equipment market and only a modest 10% penetration of the home market, the wide scope for further growth in the 1990s is expected to sustain the sizeable number of producers in the industry.

Exports will spur the internationalization of major facsimile equipment producers. Although overseas shipments rose only 7.6% in the first 7 months of 1983, total 1982 exports shot up 83% to approximately Yen 40 billion, representing a 68% increase in volume to 63,300 units. The higher increase in the value of exports, exceeding the increase in export volume, reflects the greater advantages of Japanese higher-speed terminals.

Significantly, the relatively high rate of exports, which amounted to almost 27% of total sales in 1982, has been sustained less by direct marketing abroad by Japanese firms than by United States and European OEM (original equipment manufacturer) purchases in Japan. These supply arrangements, as of 1982, are illustrated in Table 2.

By comparison, leading Japanese manufacturers are estimated to have shipped only 15,000 units to the United States and 5000 to 6000 units to Europe under their brand names.

Indications are that this pattern of supply will continue for the foreseeable future. With rapid improvements in production efficiency through the application of more automated mass production methods Japanese manufacturers have reduced unit prices by more than 26% since 1980. Technological innovations, especially in LSI design and applications, have not

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Table 2

U.S.	Units	Europe	Units
Fujitsu to Burroughs	5000	Fujitsu to ITT Europe	3000
Murata to Burroughs	3000	Mitsubishi Electric to Siemens	2000
Oki Electric to Pitney-Bowes	7000	Ricoh to Kalle Infotec	2000
Toshiba to Pitney-Bowes	8000	Oki Electric to DeTeWe	2000
Hitachi to Southern Pacific Communications	2000	Oki Electric to Muirhead Corporation	2000
Hitachi to Telautograph	2000		

only brought miniaturization and higher quality, but also have lowered the costs of parts and components. Moreover, Japanese facsimile units now are equipped with levels of functionality unmatched by those produced in the United States and Europe.

As a result, in 1982 the British Post Office and the Swedish Telecommunications Agency (STA), for example, concluded contracts directly with Matsushita Graphic Communications for supply of mini-fax machines. Since the STA reportedly is planning to use Japanese mini-fax equipment in its nationwide communications network redevelopment program, Japanese facsimile exports to Sweden alone could amount ultimately to hundreds of thousands of units.

Spurred by this rise in exports of facsimile sets, overseas shipments of telecommunications equipment rose a spectacular 57.1% in 1981 and continued upward at a 21.7% rate in the first 7 months of 1983. Prospects are that, just as exports have led the growth of other electronic industry sectors in the past, the growth in the Japanese communications industry during the 1980s will be spurred by overseas sales. By 1986, exports are expected to account for approximately 30% of total telecommunications equipment shipments.

Market targets

At the same time, Japanese equipment manufacturers will move toward increasing manufacture of major products in key foreign markets. NEC, Fujitsu and Oki have begun to manufacture PABXs (private automatic branch exchanges) in the United States, and Fujitsu has plans for United States production of optical fiber communications-related equipment, the fiber excepted, in conjunction with an order from MCI Communications for installation of a long distance optical fiber communications system between Washington and New York.

Parallel to the rise in exports, private demand for communications equipment in Japan will continue to grow faster than purchases of NTT, Kokusai Denshin Denwa Co. Ltd. (KDD) and other public sector users. In 1986, equipment sales to the private sector are expected to exceed Yen 697 billion, estimated at 35.5% of total production, or about the same as the 35.6% taken by sales to public communications systems operators.

Further liberalization of the market for telephones and interconnect regulations for value-added networks will have a significant impact on the market for new generations of terminal equipment. Not only will an increasing share of home telecommunications equipment be sold by the manufacturer to the consumer through a variety of retail outlets, but customer-premises sales of digital exchanges, key telephone systems and local area networks will grow rapidly.

Radical changes in technology, combined with changing patterns of demand are transforming the structure of the telecommunications equipment industry. With the development of optical fiber communications, cooperation between cable manufacturers and equipment manufacturers is becoming even closer than it was in the age of copper wire. Satellite communications, a macro-technology susceptible to management only by large-scale enterprises, will increase the share of major equipment manufacturers in transmission equipment markets. Similarly, digital exchanges, like mainframe computers, have high levels of minimum efficient scale of production and, therefore, are likely to add to the power of major manufacturers in the marketplace.

Small and medium-sized telecommunications equipment manufacturers will lose market share for cable, transmission equipment and exchanges to the larger diversified communications companies, on the one hand; on the other hand, they will be faced by rising competition for terminal markets from consumer electronics and office equipment manufacturers.

Virtually all major appliance manufacturers and office equipment manufacturers have diversified into telecommunications terminal production in recent years and are likely to be leading suppliers of personal computer—or data communications—terminals and facsimile equipment, as well as television and other video equipment connected to the communications network.

Indeed, the advantage of appliance manufacturers is so strong that major communications equipment firms, such as NEC, are investing heavily in consumer electronics production to acquire the mass production capabilities that will be required to compete effectively in the terminal markets of tomorrow.

Trepidation

Quite understandably, foreign communications equipment suppliers view this trend with mixed feelings. While some specialized communications equipment manufacturers are confident they will be able to compete more effectively in the Japanese market after privatization of NTT and with the growing importance of the private sector, others are less optimistic.

Just as improved technology, higher domestic performance specifications and quality standards, and superior mass production capabilities are serving to make Japanese communications equipment increasingly attractive abroad, foreign suppliers will have to compete with this combination of advantages in the Japanese domestic market. Private buyers tend to be just as concerned with performance and quality as the public services, and they are even more impervious to international political pressures.

But that is not all. "There is the classic problem of interface between foreign manufacturers and the Japanese market that must be solved," a Tokyo representative of one leading international equipment manufacturer confessed. "The home office blames the Japanese and the branch office for failure to penetrate the mar-

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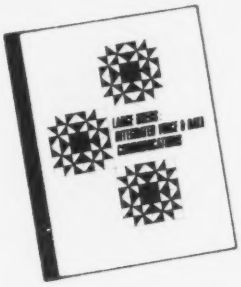

The results of the 1984 survey of large users shows better than 70% of corporate users will have integrated voice-data communications departments by 1986. Accompanying that integration is the authority to integrate voice and data facilities, with markedly increased plans for digital termination (bypass) facilities and purchases of voice-data PBXs.

Over 30 key system and PBX manufacturers and over 50 modem, multiplexer and data switch manufacturers were named by the telecom professionals as coming to mind when considering purchases. But, manufacturers need to be cautious, since sector usage levels and demands vary.

The large user is making distribution channels as important as the equipment manufacturer. The integration of voice and data communications also is increasing the degree of centralized buying. The surveyed corporations' HQ telecom staff control 31% to 83% of voice and data communications acquisitions in locations ranging from 1-9 employees on up to over 1000 employees, underscoring emphasis on network compatability, and backup service, which past surveys have shown as the most important factor in purchase decisions.

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ket, but is not prepared to do the homework or modify the equipment to meet NTT standards. "We have to face the facts," he continued. "NTT standards are tighter, and in other ways special, but they are not going to relax them simply to please or accommodate foreign suppliers."

The plain truth of the matter is that, for many of these firms, meeting Japanese (not only NTT) specifications at competitive prices and normal business risks is not feasible. The volume of sales, under the best of all possible conditions, often does not warrant the investment.

But there are signs that the market is changing for some foreign suppliers. NTT has established technological ties with both International Business Machines Corp. (IBM) and American Telephone & Telegraph Co. (AT&T) which should facilitate the development of compatible systems and equipment, thus enabling these top American companies eventually to share in the Japanese market for the big ticket items which are their strengths. Motorola has been selected as a designated supplier, not only for pocket paging systems, but also for cellular telephones. Rolm has received NTT approval of its digital PABXs and private firms have been buying Rolm computerized branch exchanges (CBXs), which first appeared on the Japanese market as recently as April 1982. Fortified with this success, the company is resolved to capture 3% to 4% of the market for this type of equipment.

As a harbinger of things to come, last October Ichio Kato, NTT's director of international procurement, announced in Washington the placement of orders for an advanced traffic observation and management information collecting system from AT&T International, a $21 million supercomputer system from Cray Research, and a $4.3 million transportable digital switching system from Northern Telecom. Although sales of American firms to NTT have been doubling every year since 1981, when the agreement between the United States and Japan was signed giving American firms the right to compete on equal terms for NTT procurements, this was the largest set of U.S. equipment purchases to date.

By current industrial standards, the pace of NTT's liberalization signals a major change in policy, a change which is further reflected in the new open tender system of procurement. To expect radical changes in patterns of supply, even if the quality and prices of products are competitive with those being used, flies in the face of the reality of telecommunications systems' imperatives.

All products must be compatible with the total system and with its various components, which usually means that individual products must be designed for the needs of the system if optimal results are to be obtained. This limits the number of equipment items that can be bought off the shelf and requires rather lengthy lead time between the design stage, the placement of orders and final delivery.

The question suppliers are asking now is: Will NTT continue on its present course of liberalization after it becomes a private corporation?

Although NTT will not be legally bound to comply with the procurement agreement once its status as a public corporation is withdrawn, there are good reasons to expect that purchases abroad will continue to increase. As an executive of one American equipment supplier put it: "The important thing is that recent changes in the climate induce foreign firms to try harder."

But, equally important, NTT will no doubt remain committed to the path of cooperation it has taken with its recent technical relationships abroad.

There are also some sound technical and economic reasons for an increasing specialization and international division of labor as telecommunications technologies and products proliferate. As uniformity in global communications systems becomes increasingly important, there is likely to be a growing trend towards standardization and compatibility of systems and equipment. Closer cooperation between communications utilities and suppliers throughout the world, therefore, becomes one of the positive features of the fifth communications age.

Liberalization of communications systems the world over also will enhance the importance of private sector markets and increase world trade in communications equipment. Although Japanese telecommunications equipment manufacturers will be major competitors in this new global environment, effective competition in this field often requires international cooperation.

Increased international competition and cooperation thus become the logical pattern for members of the communications industry in the information age. □

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Is there a satellite in Korea's future?

EITEL M. RIZZONI and DONALD K. DEMENT

AT THE REQUEST of the Government of the Republic of Korea, Teleconsult Inc. has done a feasibility study on the construction of a satellite system that would be integrated with the national telecommunications system.

There are five separate major functions required of the satellite system: four communications networks; two video relay and television community-service channels; three direct broadcast channels, remote sensing; and satellite protection and system security. These represent a diverse set, and result in a design for a hybrid-service system. Networks are varied. A 2000-circuit requirement for telephone traffic and a 1000-trunk data communications network is required between major-city nodes. A separate 200-circuit network is required for 20 remote islands. Data requirements for a wide range of services, including a variety of systems for flood warning, meteorological data, railroad information and power plant data control, have been addressed by a special network. Finally, approximately 50 mobile/transportable terminals will be employed, with an 800-circuit requirement.

'As projected from 1983 to 1986 needs, total terrestrial telecommunications in Korea is growing, and is expected to continue growing for the next decade, at a rate of 30% each year.'

As projected from 1983 to 1986 needs, total terrestrial telecommunications in Korea is growing, and is expected to continue growing for the next decade, at a rate of 30% each year. Based on these rapid increases and future demands, a spacecraft and earth terminal design has been developed that will provide three to four times more circuits than are presently needed. This growth factor can be accommodated with little cost to the spacecraft. The earth terminal system then can grow as needs arise.

Two types of television service have been requested, one for community reception and subsequent redistribution, and the other for direct reception to individual homes and businesses. An implicit requirement is the ability to distribute domestic TV coverage of the 1988 Olympic Games, which will be held in Seoul, and to interconnect that coverage with worldwide retransmission facilities.

The community distribution is designed for two satellite transponders, and a third may be implemented. The video relay need is satisfied by remote feeder service using fixed-service transponders to a

Eitel M. Rizzoni is President and *Donald K. Dement* is Vice President for Satellite Systems at Teleconsult Inc., Washington. This article has been adapted from a paper presented Aug. 5, 1983, at the World Communication Year '83 (WCY '83) International Telecommunications Forum in Seoul, Korea. The authors also would like to acknowledge the contributions of Willis DeHart, Frank Mulholland, John Tatlock, Peter McManamon and Linda Bower.

Table 1
Cost comparison of the three options
Korean satellite system, lease from INTELSAT and terrestrial system
($ Millions)

	Investment Year	System Operation Year 1	2	3	4	5	6	7	Total over period
Korean Satellite System									
Capital Cost	257.4	—	—	—	—	—	—	—	
Annual Operating Cost	—	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Total	257.4	5.0	5.0	5.0	5.0	5.0	5.0	5.0	292.4
							Less: Unused capacity		- 134.7
									157.7
Lease Capacity from INTELSAT									
Capital Cost	42.7	—	—	—	—	—	—	—	
Annual Operation Cost	—	36.1	36.1	36.1	36.1	36.1	36.1	36.1	
Total	42.7	36.1	36.1	36.1	36.1	36.1	36.1	36.1	295.4
Terrestrial System									
Capital Cost	53.6	—	—	—	—	—	—	—	
Annual Operating Cost	—	5.4	5.4	5.4	5.4	5.4	5.4	5.4	
Total	53.6	5.4	5.4	5.4	5.4	5.4	5.4	5.4	91.4

central broadcast and monitoring facility in Seoul.

The dominant requirement is for direct broadcast service. This prerequisite dictates the need for three separate transponders.

An objective of the broadcast service capabilities of the spacecraft is to send to nearly 100% of all household's the current four channels of national television coverage. A mix of direct broadcast earth terminals together with community service earth terminals feeding low-power rebroadcast stations is recommended.

The radio regulations of the International Telecommunication Union (ITU) assign to Korea an orbital location for broadcast satellite service (BSS) at 110° east longitude, using direct polarization with even-numbered channels from 2 to 12. Using a slightly modified coverage area, the fixed satellite service (FSS) channels can be operated advantageously from the same spacecraft. The approval of an application for the use of this position must be obtained from the International Frequency Review Board as early as possible to receive assurance of use and coordination rights.

A shared FSS/BSS band with a relatively high power flux density (PFD) -111 dBW/m^2 is also assigned between 12.5 and 12.75 gigahertz (GHz). While it is required not to interfere with the systems of other countries, which limits PFD outside Korea, this requirement can be met with a relatively fast roll-off of antenna patterns.

Coordination with Japan in regard to the earth terminals to be used with the BS-2 spacecraft (which was launched in January, is co-located at 110° east and operates on channels 11 and 15) should be of minimal difficulty because of opposite polarization sense and the use of different channels.

This high PFD limit requires of the satellite only a modest transmitter power because of its antenna's beamforming and high gain. Together, they bring to the earth terminal system the advantages of relatively small size and modest receiver noise performance requirements, which will minimize the earth segment costs and permit wide proliferation of Korean satellite broadcast receiver systems.

The requirement for special data circuits for remote sensing would be accomplished by the use of an ultra-high frequency (UHF) receiver on the spacecraft. The relay of ground-sensed events is practical by using small, unattended earth terminals that periodically burst small data packets to the satellite on a UHF band allocated for meteorological aids. The satellite would relay these data on an FSS downlink channel to a central location for processing and redistribution. This system has been in use elsewhere in sensing a wide range of environmental conditions such as floods, fires, weather situations and other parameters. It can be accommodated in the design at very modest cost.

Because of the desire to implement the satellite system before 1988, only existing basic spacecraft designs and only those with known approximate cost and performance parameters and histories of good performance in orbit were considered in the feasibility study. The satelllite's communications performance, antenna coverage-area design and its size, mass estimates, launch availability, minimized costs and other factors, have led to the recommendation of a "Delta-sized" satellite. Reservation contracts and other arrangements must be made soon for a suggested launch not later than the winter of 1987.

The spacecraft's half-power antenna coverage pattern would include a considerable portion of Japan and North Korea. The broadcast transponder system, if chosen to provide effective isotropic radiated power (EIRP) of 59.5 dbW at the half-power beam edge, meets the PFD limit of minus 103 dbW/m2. The resulting traveling wave tube (TWT) transmitters would be required to furnish 60 W each. Using known and available 100 W TWTs operated at 60 W, the three operational broadcast TWTs together would demand about 750 watts of direct current (dc) power. For known spacecraft designs, this permits seven to eight transponders for fixed-service operation, in addition to the five to six broadcast channels. However, the power radiated outside the desired area is not useful—no other lower-priority functions can be served—and this is not a conservative dc power design for this early, conceptual stage.

An alternative, "largest-antenna" approach was also considered. Using an 84-in. shroud limit, the maximum-sized, circular, symmetrical antenna would provide a half-power beam width of 0.824° at 11.7 GHz. Its gain of

Continued on page 40

46.1 dBi leads to the use of 30 W TWTs for BSS and 16 5-W TWTs for the FSS. This permits the three DBS channels and the two video relay channels in the BSS band, plus 16 FSS transponders, to be operated with dc power margin remaining. The pattern, however, is restricted so that the major Korean islands are not covered, and the sharp pattern-edge roll-off would be noticeable in the case of any spacecraft motion from natural disturbances or maneuvers.

A third design using an elliptically-shaped, fast roll-off pattern reflector solves these problems, while still fitting the desired shroud limits. As shown in Figure 1, the elliptical pattern results in better island coverage of 1.2° by 0.8°. The resulting broadcast system, using three 40 W TWTs requiring 300 W dc, three 10 W TWTs for the video distribution system, and the 16 FSS transponders using 5 W TWTs, would require a total of less than 500 watts. This is suitable for the use of existing spacecraft buses.

A Ku-band frequency plan has been proposed. The 16 FSS transponders would occupy the full 12.5 to 12.75 GHz band, using a cross-polarized feed system to provide for frequency re-use in 27 megahertz (MHz) channels. The 27 MHz transponder bandwidth is optimal for the use of medium-speed time-division multiple access (TDMA) at 45 megabits per second (Mb/s). With additional ground-based equipment, expansion to 90 Mb/s service is possible. Land mobile satellite service is permitted in the recommended uplink band—14.0 GHz to 14.5 GHz—and can operate with small and low-cost antennas.

The uplink parameters were selected to be 14.0 GHz to 14.5 GHz for the FSS, and 14.5 GHz to 14.8 GHz for the BSS. A millimeter-wave command system is recommended, with processing (encryption, spread spectrum) as required. The total band occupancy of both services is only 460 MHz, which makes possible the unification of earth terminal transmitter design. An optional cross-strap of transponders between three FSS channels and three community television channels would permit transmission from the satellite in the BSS band from any of the FSS terminals, as desired. In this way, the FSS stations can optionally be used to either relay events to a central uplink or to be designated for direct broadcast from their location without an additional DBS transmitter.

A design for an inter-city network was made based on information about traffic furnished by Korean Electrotechnology and Telecommunications Research Institute (KETRI). The considerable expansion in capability of the spacecraft FSS will permit new traffic to be carried, as desired, with little concern for saturation of the spacecraft facilities for many years.

Using multiple-carrier FDM/FM/FDMA (frequency division multiplex/frequency modulation/frequency division multiple access), the 27 MHz transponders can handle 10 carriers each with about 1200 one-way trunks not using companding or time-assigned speech interpolation (TASI) techniques.

With companding, two transponders will satisfy the 4000-channel requirement, and permit expansion via ground facility installation of other compression techniques as future requirements dictate.

The 27 MHz transponder capacity for digital service, using TDM/PCM/PSK/TDMA (time division multiplex/pulse code modulation/phase shift keying/TDMA) techniques, is about 640 channels and, with digital speech

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Table 2
Cost of Korean satellite system

	Investment Year	System Operation Year 1	2	3	4	5	6	7	Total over period
		$ Millions							
Capital cost									
Space Segment									
Spacecraft: 2 @ $43.3 million	86.4								
Launch: 2 @ 36.0	72.0								
Insurance	15.8								
Launch support: 2 @ $5.0 million	10.0								
SOCC: 2 @ 15.0	30.0								
On-orbit test/checkout	0.5								
Sub-Total	214.7								
Earth Segment									
10 Major City Telephone	6.6								
Data Communications	16.5								
Remote Islands	3.3								
Mobile/transportable	12.1								
Direct broadcast	3.9								
Video relay	0.3								
Sub-Total	42.7								
Total capital cost	257.4								
Operating cost									
Space Segment	-	.7	.7	.7	.7	.7	.7	.7	
Earth Segment		4.3	4.3	4.3	4.3	4.3	4.3	4.3	
Sub-Total Operating Cost		5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Total annual expenditures	257.4	5.0	5.0	5.0	5.0	5.0	5.0	5.0	292.4

interpolation (DSI) implemented, about 1280 one-way trunks can be transmitted serving the entire 10-city network. Advanced techniques can expand capacity per transponder to a one-way trunk volume of 5120. To meet this high capacity and utilize the flexibility of digital transmission, and for several other reasons, the recommended modulation and multiple-access technique is all-digital.

A fully-connected 2-meter antenna terminal employed in a mesh network has been designed for the data, remote island and mobile services. Considering both analog and digital designs, three transponders are required. The capacity of the transponders would be 2700 one-way channels, which meets the 2400-channel data requirement, using either digital or analog systems. Using demand assigned multiple access (DAMA), the mobile needs also can be met with the same three transponders. An additional transponder is assigned to the remote island network in order to keep the digital and analog traffic separate. Total need is six, but seven transponders are recommended to avoid mixing modulation types, in order to maximize power utilization and efficiency. As desired, there would be additional transponders available for alternative solutions.

For Olympic coverage, the satellite system will be used with the mobile/transportable terminals, fitted with television modems. If the five terminals regularly required are not sufficient, or if event schedules prohibit timely relocation, additional terminals could be leased, all for inward feeds to a central broadcast and program facility at Seoul. The broadcast facility can then provide Ku-band feeds to the satellite broadcast transponders for Korean national coverage, C-band feeds to the International Telecommunications Satellite Organization (INTELSAT) station for worldwide coverage, and to cable systems in Japan, and to supplemental INTELSAT feeds, as required.

Direct broadcast reception

The application of DBS power levels will permit the use of small earth terminals located at individual households and businesses. These terminals are presently under development and near production for use with DBS systems being planned or under construction in Europe, Japan and the United States. They are estimated to cost as little as $250 to produce in large quantities, and after other costs of marketing, shipping, distribution networks, installation, training and other variables, should sell for less than $500. They also may be set up for leasing in cases where possible reinstallations are still cost-effective, and when early widespread network usage is desired.

Using the recommended 0.8 meter antennas and a 4.0 dB noise figure receiver, the expected video signal-to-noise ratio will be 47.5 dB—providing a high-quality picture. The satellite system also will provide freedom from multipath "ghosting" and fading.

Access to television signals from the satellite should be excellent in Korea, because the elevation angle to the satellite will always exceed 42°. While severe rain conditions can cause fading at 12 GHz, rainfall rate statistics for Korea show a quite favorable situation for the use of this frequency; outages will be very infrequent. The signals from these earth terminal receivers would be connected to a television set's monitor input, or to a modulator to upconvert to an unused very high frequency (VHF) channel. The earth terminals are an obvious technology transfer area for manufacture within Korea.

The community broadcast receiver systems must provide slightly higher signal strength, because the rebroadcast sequence will degrade the quality somewhat. The terminals can use the same receiver, but the antenna should be a little larger. A 1.2-meter antenna is recommended. Low-power television translators or rebroadcast facilities can serve as a multiplier for the DBS programing where open television channel frequencies are available, and reception is difficult or impossible. Transmitter costs dominate, but are spread over hundreds of viewers. The relative cost for each application requires detailed study for least-cost implementation.

Costs have been estimated for the Korean satellite system, for an INTELSAT leased space segment plus Korean earth segment and for a terrestrial system which satisfies some but by no means all of the network and television requirements. Terrestrial and satellite systems are not comparable. There are satellite system telecommunications functions that are impossible to achieve with a terrestrial system, such as Korea's mobile telecommunications needs, service to remote islands and near total television coverage. Thus, while the cost for a terrestrial system appears to be less than that of a satellite system, the terrestrial system is by far inferior; indeed, it is unacceptable because it does not, and cannot, perform as required. Therefore, a low cost is meaningless. In fact, an opportunity cost should be added to the actual cost of the terrestrial facilities to account for the lost service. Korea's requirements can be effectively served only by satellite. However, costs for a terrestrial system also have been considered.

In case of a lease for an INTELSAT V 14/11 GHz east spot beam with the same EIRP as the Korean satellite, the corresponding annual charge

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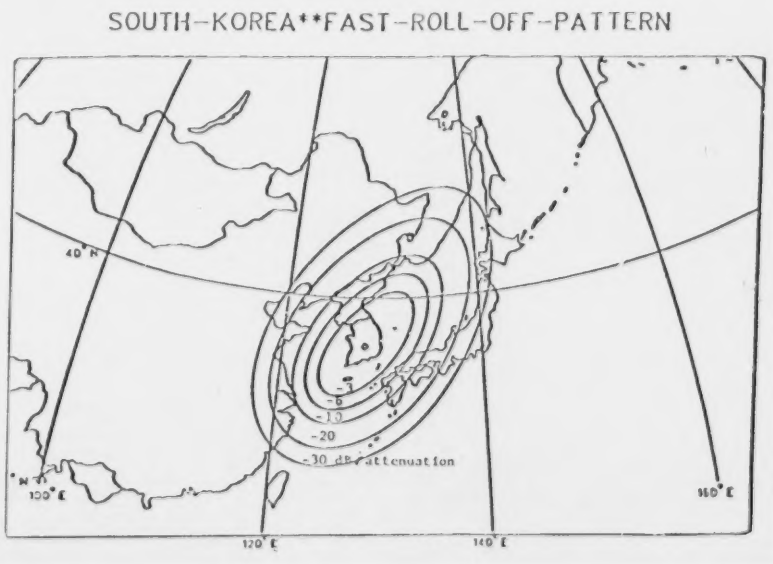
FIG. 1 *An illustration of the elliptical optimum footprint.*



'All of the Korean national coverage requirements, network requirements and direct broadcast requirements can be met using low-risk satellite and small earth terminal system designs.'

has been calculated for the number of INTELSAT (International Telecommunications Satellite Organization) lease units equivalent to the initial transponder service requirement of the Korean satellite system. The cost of the earth segment is the same in the two cases.

The proposed Korean satellite will provide a capacity of at least three times that required for the initial services desired. Therefore, for proper economic comparison with an INTELSAT lease, only one-third of the space segment cost of the Korean satellite should be attributed to the project under study. To obtain a net cost attributable to the project, it is necessary to subtract an amount proportional to the unused capacity of the space segment.

The comparison of annual expenditures (capital plus operating costs) for the three alternatives over a 7-year minimum project life is shown in Table 1. Table 2 shows the estimated cost for the Korean satellite system major elements.

In addition to its higher cost, leasing capacity from INTELSAT presents the disadvantage that Korea would not have control of the space segment; this fact will limit the use of the satellite for whatever purpose Korean authorities may wish. Sovereign use of the space segment is of the utmost importance to Korea. Therefore, an opportunity cost could be added to the INTELSAT lease which would bring the value of the leasing alternative even higher than the ownership alternative. This confirms the logical choice that the preferred alternative is for Korea to develop its own satellite system.

The economic cost comparison among the three alternatives is: Korean satellite system (one-third transponder capacity), $157.5 million; comparable INTELSAT lease, $295.4 million; and non-comparable terrestrial system (meeting only some requirements), $91.4 million. Thus, a Korean satellite system is the only viable solution for meeting the requirements.

All of the Korean national coverage area requirements, network requirements, and direct broadcast requirements can be met using low-risk satellite and small earth terminal system designs. Antenna patterns can be modified to optimize this domestic satellite system, while keeping full regard for the CCIR's power flux density and interference level requirements outside the country. If the schedule proceeds very soon, as recommended, worldwide and regional Olympic coverage requirements can be met via this satellite system when added to the central broadcast facilities and INTELSAT distribution capability. The direct and community broadcast facilities will move the nation toward 100% television reception, while providing an opportunity to join in a growing, worldwide business field.

Moreover, major significant advantages to Korea in owning and operating its own satellite system are:

- Technically, it will integrate the network and accelerate the evolution of the communications network into an all-digital national ISDN (integrated services digital network). It will also implement important alternative routings.
- It will provide remote, mobile and strategic communications, nearly total television coverage and educational television, all of which will result in economic and social development and stimulate national unity.
- It will permit total broadcasting of the 1988 Olympic Games, nationally and internationally.
- It will stimulate new product manufacturing, transfer of new technology, and advancements in research and development.
- It will provide secure circuits.
- It will provide an ideal means of coping with national emergencies through transportable and mobile units located in strategic centers of the nation.
- As an indirect benefit, it will discourage migration from previously unserved remote areas to the crowded cities while providing an incentive to develop such areas.
- It will have a favorable impact on the country's image in international circles. The capability to plan and implement such an important project will bring momentous national significance and international prestige.

The prospects for satellite communications in Korea are bright indeed. □

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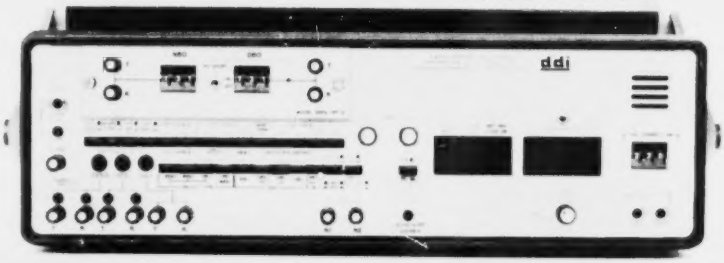

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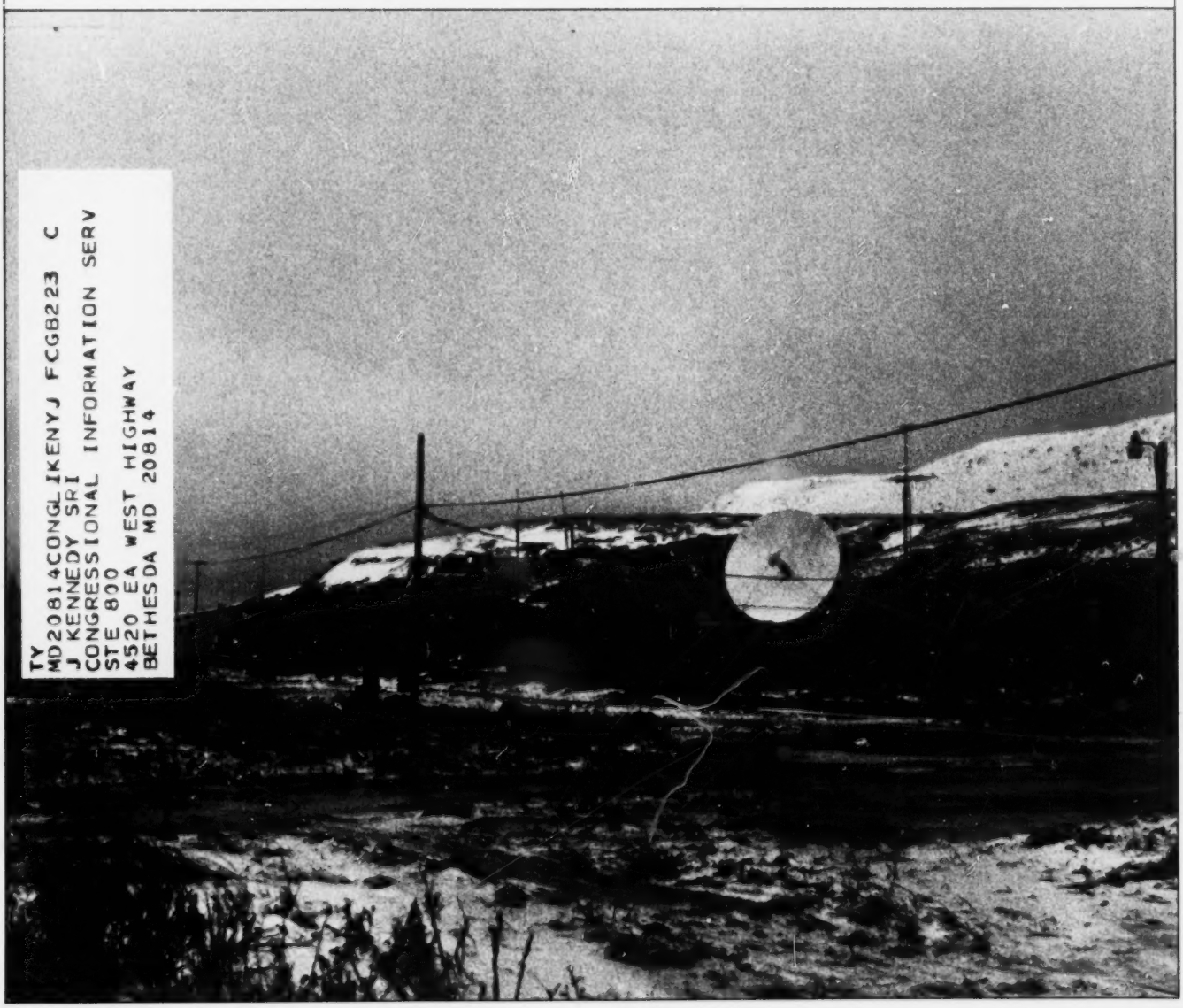

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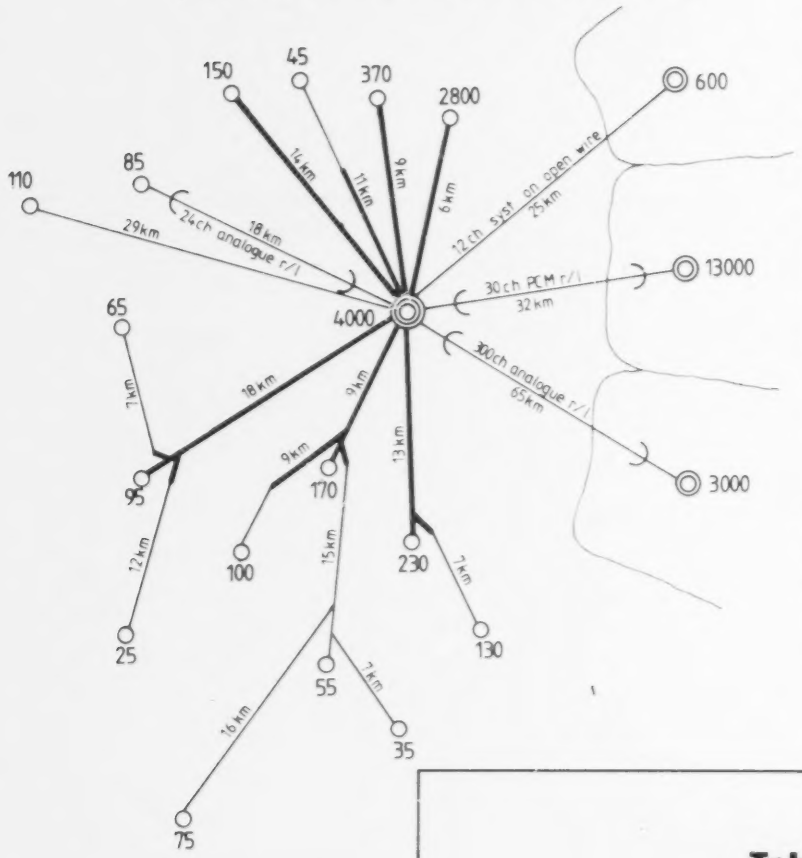
Telecommunications in rural Finland

Typical PTT Numbering Area (c. 14.000 subscribers)



○ 110 Local exchange and number of subscribers

◎ Group exchange and number of subscribers in exchange area

◎ 4000 Netgroup exchange and number of connections in subsriber stage

——— Open wire

━━━ Cable

⟷ Radio link

FINLAND is one of the most advanced countries in the world with respect to telephony. The telephone density was 52 telephones per 100 people in 1982, with a wide range of services and low tariffs. This shows that telecommunications can be managed effectively even though most exchanges are small (less than 500 numbers) and the junction and subscriber lines are long.

The average density of the population in Finland is 15.7 people per square kilometer; in some municipalities it is less than 2. Owing to the sparse population and the abundance of waterways the telecommunication networks consist of small exchanges, low capacity transmission systems and long junctions.

Despite the fragmentation of networks, the level of service is high, even in areas of very spare population, as is shown in Table 1 on this page.

To keep the level of service high and to maintain equal regional distribution the operating organization must have a good grasp of technology and skilled personnel. The Finnish PTT is a good example of such an organization. When operations are well managed, not even natural disasters can paralyze the network for long. □

Table 1
Characteristics of the telephone service (PTT's area, 1982)

Population density (population/sq. km)	Telephone density (phones/100 persons)	Mean delivery time of orders (weeks)	Mean fault repair time (hours)
Cities and towns 20.6	49.9	<2	<48
Rural areas 4.4	41.0	<2	<48

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FCC permits AT&T units, BOCs to enter new markets, p. 14

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Progress report: North American installations of time division digital switches

AMOS E. JOEL JR.

For the past 3 years, Amos Joel Jr., formerly of AT&T Bell Labs, now executive consultant for AT&T Technologies, has been providing TELEPHONY with hard data on progress made in installing time division digital switches in North America. This report includes the results for 1983, which are presented as Tables 5 and 6. It also includes the data for 1982, presented as Tables 3 and 4, and 1981, presented as Tables 1 and 2. Tables 1, 3 and 5 include information on which types of digital switches were installed and their size and location. Tables 2, 4 and 6 include information on the largest offices of each type of equipment. Tables 1 and 2 originally appeared in TELEPHONY, June 21, 1982, p. 32. Tables 3 and 4 first appeared in TELEPHONY, Aug. 22, 1983, p. 101. Tables 2, 3, 4, 5 and 6 appear on pp. 56 and 57.

Table 1

North American time division digital switching*

System	No. 4 ESS	ITS 4/5	DCO	DMS 10	No. 3 EAX	1210	DMS 100/200/ 300	NEAX 61	Totals
1. First service	1'76	3'76	7'77	10'77	3'78	9'78	4'79	5'79	
2. Base units in service as of year end (YE) 1981									
a) Total	74	165	219	443	33	112	150	47	1243
b) Class 5	NA	125	214	441	NA	77	92	33	982
c) Class 4/5	NA	22	4	(1)	NA	27	34	12	99
d) Class 4 only	74	18	1	2	33	8	24	2	162
3. Remote switching units in service YE 1981									
a) Total	NA	315	131	98	NA	50	63	29	686
b) On base units	NA	315	131	98	NA	50	63	0	657
c) On remotes	NA	NA	N/A	N/A	NA	NA	NA	29	29
4. Total lines in service YE 1981	NA	180K	380K	616K	NA	375K	910K	187K	2648K
5. Trunks in service YE 1981 on Class 4 or Class 4/5 offices	2174K	70K	37K	NA	149K	35K	137K	10K	2612K

*Year end 1981
NA—Not applicable
N/A—Not available
(1)—Included in Class 5

Table 2

North American time division digital switching*
Largest offices (YE 81)

System	Local		Toll		Local/toll	
	Location	Lines	Location	Trunks	Location	Terminations
No. 4 ESS	NA	NA	Houston	59.3K	NA	NA
ITS 4/5	St. Mary's, Ga.	5.6K	Gander, NF	1.2K	Mauston, Wis.	6.5K
DCO	S. Katy, Texas	7K	Boscobel, Wis.	1K	Middleton, Wis.	10.8K
DMS 10	Harrison, Ark.	5.1K	Redmond, Calif.	406	N/A	N/A
No. 3 EAX	NA	NA	New Westminster, B.C.	13.K	NA	NA
1210	Jefferson City, Mo.	20K	Glenwood, Ark.	2K	Roseville, Calif.	13K
DMS 100/200/300	Runnymede, Ont.	43.5K	Montreal	27.7K	Kitchner, Ont.	41.2K
NEAX 61	Victorville, Calif.	11.8K	Winter Park, Fla.	3.5K	Ridgecrest, Calif.	8.8K

* Year end 1981
NA-Not applicable
N/A—Not available

Table 3

North American time division digital switching
(1982)

System	ITT/North 1210	No. 3 EAX	No. 5 EAX	NEAX 61	DCO	DMS 10	DMS 100/200/300	ITS 4/5	No. 4 ESS	No. 5 ESS	Totals
1. Base units in service YE 82											
a) Total	163	36	10	78	292	612	263	183	90	2	1729
b) Class 5	111		10	63	286	597	148	125		2	1342
c) Class 4/5	42			13	5	14	67	41			182
d) Class 4	10	36		2	1	1	27	17	90		184
e) Other							21				21
2. Number of remote switching units in service YE 82											
On base units	75			49	141	145	248	319			977
3. Number of total lines in service YE 82	573K		25K	323K	509K	896K	1857K	308K		3K	4494K
4. Number of trunks in service YE 82 (Class 4 or 4/5)	57K	204K		16K	53K	3K	297K	19K	2713		3362K
5. Total systems and lines on order or expected YE 83											
Systems	N/A	39	650	145		1175	550	N/A	98	N/A	
Lines	N/A	N/A	3M	320K		1.5M	5M		NA	N/A	
Trunks	N/A	250K	NA	139K		NA	700K		N/A	N/A	

* +525 remotes
N/A—Not available
NA—Not applicable

Table 4

North American time division digital switching (largest offices)

	Local		Toll		Local/toll	
System	Location	Line	Location	Trunks	Location	Terminations
ITT/North 1210	Jeff. City, Mo.	20K	Jeff. City, Mo.	2.3K	Roseville, Calif.	4K
No. 3 EAX	NA	NA	Calgary, Alberta	5.8K	NA	NA
No. 5 EAX	First Colony, Texas	6K				
NEAX 61	Victorville, Calif.	13.7K	Winter Park, Fla.	5.8K	Thomaston, Ga.	10.4K
DCO	Ville Platte, La.	7.5K	Boscobel, Wis.	1K	Middleton, Wis.	10.8K
DMS 10	Harrison, Ark.	6K	Pearce, Ariz.	250	Pinetop, Ore.	2.1K
DMS 100/200/300	Toronto, Ont.	43.5K	Toronto, Ont.	23K	Kitchener, Ont.	40K
ITS 4/5*	St. Mary's, Ga.	7K	Gander, Newfoundland	1.2K	Mauston, Wis.	6.5K
No. 4 ESS	NA	NA	Los Angeles, Calif.	70.4K	NA	NA
No. 5 ESS	Cedarville, Ohio	2K				

NA—Not applicable
*—1981 data

Table 5

North American time division digital switching (YE 83)

System	ITT/North 1210	No. 3 EAX	No. 5 EAX	NEAX 61	DCO	DMS 10	DMS 100/200/300	ITS 4/5	No. 4 ESS	No. 5 ESS	AXE 10	E10-5 (TSS)	Totals
1. Base units in service YE 83													
a) Total	191*	27	75	104	402	794	384	183	99	13	1	2	2274
b) Class 5	137		68	77	375	778	215	125	NA	11		2	1687
c) Class 4/5	44		6	19	22	15	92	41		2			241
d) Class 4	10	27		3	5	1	35	17	99				197
e) PABX-CPE			1	N.A.			8						9
f) International	gateway				2			1		(8)			
							3						
g) OCC tandem				3			32				1		36
h) Mobile radio													
2. Number of remote switching units in service YE 83													
	95	NA	5	68	208	189	276	319		NA			960
3. Thousands of total lines in service YE 83													
	712	NA	550	410	739	1181	2800	368	NA	66		3	7429
4. Thousands of trunks in service YE 83 (all classes)													
	66	233	21	77	96	7	500	23	2975	5			4003

N.A.—Not available
NA—Not applicable

Table 6

North American time division digital switching largest installations (YE 83)

System	Local		Toll		Local/toll	
	Location	Lines	Location	Trunks	Location	Terminations
1210	Jefferson City, Mo.	20,140	Jefferson City, Mo.	2324	Roseville, Calif.	4000
DCO	Cheshire, Conn.	10,000	Boscobel, Wis.	1000	Middleton, Wis.	10,800
DMS 10	Harrison, Ark.	6300	Redmond, Ore.	800	Cheyenne, Okla.	1700
DMS 100 family	Toronto, Ont.	40,000	Montreal	29,900	Butler, Pa.	27,120
EAX 3			Calgary	15,360		
EAX 5	Lincoln, Neb.	25,000	Oberlin, Ohio	883	Lafayette, Ind.	10,888
ESS 4			Los Angeles	71,000		
ESS 5	Bradford, Pa.	12,000			Leesberg, Va.	13,000
NEAX 61	Victorville, Calif.	13,752	Winter Park, Fla.	5640	Thomaston, Ga.	10,246
E10-5	Cloverdale, Ind.	4,200				

IEEE: the pivot of standards work in the United States

IEEE plays a crucial role in the development of technical standards. This article reviews the history of the IEEE and its functions in terms of standards work

J.L. KOEPFINGER

ALTHOUGH MANY people may not recognize the importance of standards, without them technological progress could not have been achieved. Last year the electrical industry celebrated its 100th anniversary. This year the Institute of Electrical and Electronics Engineers, Inc. (IEEE) celebrates its 100th anniversary. Almost since its inception, IEEE has been associated with the development of standards for the electrical and electronic industry.

Early work

The IEEE was formed in 1962 from a merger of the American Institute of Electrical Engineers (AIEE) and the Institute of Radio Engineers (IRE). Shortly after the formation of the AIEE in 1883, the members became aware of the need for this professional society to have as one of its purposes the development of standards. In 1889 a committee was appointed to formulate a standard wiring table for light and power purposes.

The next action in the field of standards for AIEE (IEEE) occurred in June 1891 with the appointment of a Standing Committee on units and standards composed of such distinguished engineers as A.E. Kennelly, F.G. Crocker, W.E. Geyer, G.A. Hamilton and G.B. Prescott Jr.

The Standing Committee was instrumental in promoting the adoption of names for four magnetic units: Gilberts, magnetomotive force; Webers, Flux; Oersted, reluctance; and Gauss, flux density. It also made recommendations on standards for units and terminology in the international field of electrical engineering, by being instrumental in the adoption of the term induction with the symbol L and of the term reactance, suggested by C.P. Steinmetz.

The first official institute standard was issued on Jan. 26, 1898, by the Standing Committee and was titled, "Report of the Committee on Standardization." A principle was established by this report. The report defined characteristics, behavior, rating and method of testing of electrical machinery and apparatus. It avoided standardization of size and dimension. It is important to note that in 1898 the developers of this first AIEE/IEEE standard were leaders in the electrical engineering field. They were: Crocker, Cary T. Hutchinson, Kennelly, J.W. Lieb Jr., Steinmetz,

Continued on page 102

Table 1

Society	Approx. number of standards
Acoustic, Speech & Signal Processing Society	3
Broadcast Technology	9
Cable Television Group	1
Communications Society	23
Computer Society	4
Electromagnetic Compatibility Society	8
Instrumentation & Measurement Society	1
Magnetic Society	5
Microwave Theory & Technique Society	5
Power Engineering Society	5
Quantum Electronics and Applications Society	1
Reliability Society	1
Vehicular Technology Society	1
SCC 10 Definitions	10
SCC 14 Quantities, Units, Letter Symbols	5
Total	96

J.L. Koepfinger is Director-Protection and Communications, Duquesne Light. This article has been adapted from a presentation made on May 17, in Atlanta, at the Southeastern Telecommunications Showcase sponsored by the United States Telephone Assn. and the United States Telecommunications Suppliers Assn.

Lewis R. Stillwell and Elihic Thomson.

IEEE has functioned as a voluntary standardizing body ever since. Its standards activities have grown to include all phases of the electrical and electronic disciplines. Since about 1970 the number of standard activities of the institute have shown a dynamic increase. This reflects the impact of the maturing of the electronic technology and the need for standardization.

Standards and society

It is the goal of IEEE to generate standard publications that have the broadest potential international acceptance. In achieving this goal, IEEE depends upon the assistance of volunteers who possess the desire, the tenacity and the expertise necessary to develop standards that will provide the industry and the consumer with means to measure or compare a product and to ensure that safety has been considered, where applicable.

The institute's policy is to avoid the development on specific devices or hardware which characterizes their commercial size, arbitrary ratings or performances associated with warranties. Rating and dimensional information may be developed and included in IEEE standards provided such information results from technical consideration and is not developed by IEEE on an arbitrary basis.

IEEE, thus, provides standards with the following characteristics:

- Scientific methods of measurement or tests of the parameters or performance of any device, apparatus, system or phenomenon associated with the art, science and technology of any field within the scope of IEEE.
- Characteristic, performance and safety requirements associated with devices, equipment and systems with engineering installations.
- Recommendations reflecting state of the art in the application of engineering principles to any field of technology within the scope of IEEE.

Current activity

Standards are developed on a voluntary basis by the societies and standard coordinating committees of IEEE. There are 32 societies and 11 standard coordinating committees (SCC). Standards pertaining to the communication field are not exclusively developed within the Communication Society.

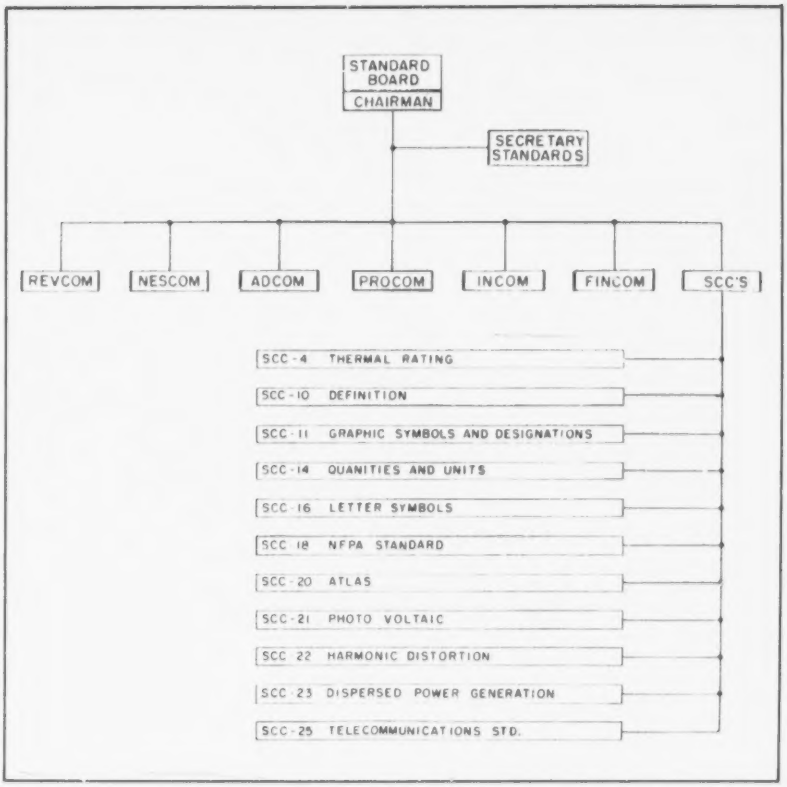


FIG. 1 *An organizational chart of the Standards Board and the Standard Coordinating Committees of the IEEE.*

The nature of communications causes it to have an affinity with other societies. Table 1 is a list of the societies and SCCs involved in the voluntary development of standards having a relationship to the communications industry.

In addition to the standard activities of the 15 societies and SCCs shown in Table 1, a new Standard Coordinating Committee, SCC 25, Telecommunications Standard, was formed by the IEEE Standards Board in 1983. This committee is chaired by Edward Cohen. Its formation was undertaken since it was recognized by the IEEE that the deregulation of the telephone industry would result in a need to coordinate within IEEE the voluntary development of standards which specifically relate to the telecommunication industry. This SCC is responsible for interfacing with the American National Standards Institute (ANSI) and other standardization bodies outside of IEEE.

Over the course of the last 15 years, IEEE has developed a structured process for standard development. This process involves all levels of the IEEE voluntary standards developing organization. To provide an understanding of the working of this system, it is useful to first understand the structure of the IEEE Standards Board and the structure of the IEEE technical activities.

The IEEE Standards Board is composed of a board of directors and six standing committees; in addition it has 11 SCCs (Figure 1).

REVCOM functions to review standards submitted for Standards Board approval. It prepares a consent agenda for the Standards Board as well as review questions on the proposed standard with its developer.

NESCOM's purpose is to review new standard projects to ensure that the standard being considered is needed and to determine that proper coordination is established. INTCOM's assistance is to assure that IEEE standards establish an interface and coordination with international standards, in particular the International Electrotechnical Commission (IEC) and the International Organization for Standardization (ISO). The remaining three committees' functions are to deal with administrative matters. SCC 25, which was mentioned earlier, is one of these committees. These committees provide a form for coordination and development of standards which

Continued on page 105

have multi-discipline interests. They, plus the technical groups and societies of the institute, provide for the voluntary development of IEEE standards.

Technical societies, through the technical committees, subcommittees and working groups, do the yeoman's work of the IEEE standard development. Generally, the development of a standard starts because a need is identified by one of the societies' entities. So that coordination is maintained and a control is achieved, the society must submit a project authorization request (PAR) to NESCOM. If the PAR is approved with the proper coordination, then the entity can begin developing the standard.

Many drafts of the standard are usually produced and exchanged with people who have indicated an interest as defined by the PAR. When it appears that adequate agreement of the subject matter has been achieved, a formal ballot is usually conducted on the proposed standard by the subcommittee. After approval by the subcommittee, a second formal ballot is conducted by the main committee or the societies' designed standard approving body. At each step, a dedicated action is required for the resolving of comments and negative ballots.

Upon approval of the proposed standard by the societies' designated standard approving body, the document is forwarded to the Standards Board where it is presented for the review and ballot of REVCOM. REVCOM prepares a consent agenda for final voting action on a standard by the IEEE Standards Board.

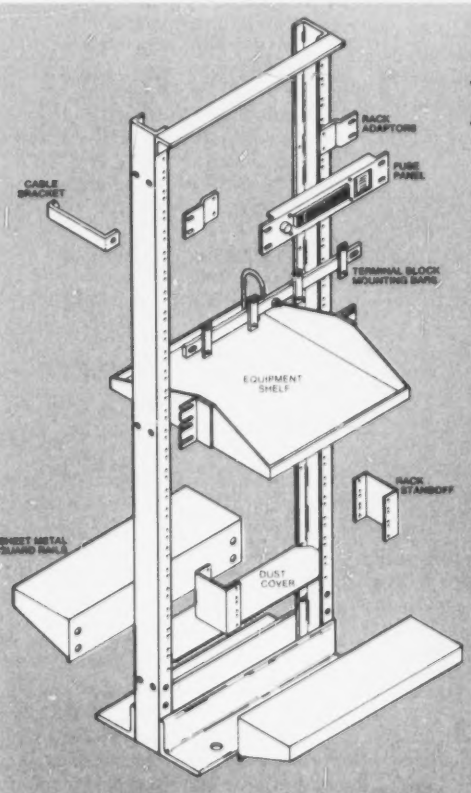
ANSI and IEEE

IEEE is recognized by ANSI as an accredited standardizing body. It, thus, in its own right can promulgate American National Standards using ANSI accredited procedure for an accredited organization. In many cases, however, IEEE standards are submitted to standard committees, such as C37, C62 and C12, for processing as an American National Standard under their sponsorship.

As an accredited standard development organization, IEEE is committed to openness in the development of standards. It provides for an opportunity for participation of all interested parties. An appeals procedure is in place to address grievances as they relate to standards development.

IEEE has a deep commitment to the development of standards. This is evident by the dedication of approximately 20,000 members who assist in carrying out the standards development. These members are assisted by the small but equally dedicated staff of the Standards Office headed by Sava I. Sherr. □

'The institute's policy is to avoid the development of standards on specific devices or hardware which characterizes their commercial size, arbitrary ratings or performances associated with warranties.'



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The Nordic Mobile Telephone System sets the stage for future mobile systems

ARTHUR CORNWELL

AT THE MOMENT, the Nordic Mobile Telephone (NMT) system is the only fully operational, large scale, trans-national mobile telephone system in the world. It was jointly developed by the national telecommunications administrations (PTTs) of Sweden, Norway, Denmark and Finland. The technology is freely available to any interested parties without payment of fees or royalties of any kind.

A short time ago, with the NMT 450 megahertz (MHz) system favorably impressing Ireland, Austria, Spain, the Benelux countries and, possibly, Italy, it appeared to be set fair toward creating a European standard. This was not to be. Competing systems like AMPS, MATS-E and NETZ-E, allied to the commercial approach being taken in countries such as the U.K., France, West Germany and the U.S. were not to be denied, and the emergence of a modified AMPS system in the U.K., designated TACS, marked the first check in the apparently irresistible march of NMT.

Since its inception in the latter half of 1981, NMT usage has increased at a high and steady rate. By the end of 1982 there were about 30,000 subscribers spread over an area of 500,000 square kilometers, an area equivalent to that of France or about twice that of England and Scotland. Accelerating at a rate of 3000 to 4000 subscribers a month during 1983, the 100,000th registration was expected during June of this year. This, from a population base of only 22 million people in the four countries, most of whom have been operating limited, manually-served mobile systems in the very high frequency (VHF) band since the early 1950s.

This photo shows a back seat extension installation of the Ericsson combined control unit and handset.

By the late 1960s the need for a fully automated system was apparent, and in 1969 the NMT working group was set up and given the task of drawing up a joint specification for a future system. Not surprisingly, in view of the time scale involved in working out an automatic system acceptable to all the Nordic countries, the first result was a new manual system in the 450 MHz band for use in Norway, Denmark and Sweden, while simultaneously Finland started a national VHF system. It was also decided to use a band in the 450 MHz range for the automatic system with the manual system channels transferred to the NMT as they were progressively taken out of service.

The basic requirements for a fully automatic system seem obvious in 1984, but this was the ambitious listing that emerged in 1970:

- The system should be capable of automatic setting up and charging of calls both to and from a mobile station.
- Conversation should be possible between a mobile station and a fixed telephone in any of the four countries.
- Conversation should be possible in any base station area or in whichever Nordic country a mobile subscriber happened to be.
- Conversation between two mobiles should be possible whether they were in the same base station area or in different areas even if these should be different Nordic countries.
- Subscriber capacity should be sufficient for a lengthy period both in respect of the number of radio channels and subscriber numbers.
- The use of a mobile telephone

Continued on page 55

Arthur Cornwell is a Consultant with Lewlin Associates, Cheltenham, U.K.

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should, as far as possible, be similar to that of a fixed telephone network.

- The system should, if technically and economically possible, permit automatic paging of a mobile subscriber and recording of the base station area in which that subscriber happened to be.
- The reliability of number transmission should be sufficiently high to satisfy the requirements of automatic charging.
- In designing the system the greatest possible attention should be given to costs, particularly the costs of the mobile equipment.
- The design of the system should not necessitate any significant changes in the existing telephone networks.
- The system should offer the same facilities as are offered for fixed telephone subscribers and should allow for charging on the basis of facilities used.
- The system should ensure a subscriber's privacy of conversation in relation to other subscribers as far as possible.

The heart and brain of the system and the most technically complex element was to be the mobile telephone exchange, which would interface between the mobile system and the fixed telephone networks which had certain national differences. It would control all processing, system maintenance, charging and network management functions. The base stations, about 900 of them at full capacity, would link the line and radio transmission functions and consist of a number of transceiver modules, according to the traffic requirements, as well as control and supervisory equipment. A single transmitting antenna would be fed from multiple transmitters through the combined network. The mobile stations would be available in various forms such as vehicle units, hand portables and fixed coin operated units. Within this framework, certain special functions would need to be provided, such as roaming, hand-off and the development of the small cell technique to increase traffic capacity in high density urban areas.

Numbering and routing systems were defined and charging principles established on the basis of initial subscriber charges, subscription fee and call charges. Additionally, there would be special facilities available—and distinction between national and international calls, all of which required the establishment of a comprehensive signal framing system using hexadecimal digits. Such board technicalities now are accepted technology for cellular radio systems and need not be reviewed in detail; it is the concept and philosophy of the system which appear to be its strength.

Swedish PTT Director Tony Hagström (above, right) is using the NMT system while Bo Magnusson, head of mobile radio services at the Swedish PTT, watches. At right, the NMT system is being used in the archipelago of Stockholm.

In developing the system, the PTTs of the Scandinavian countries gave priority to the overriding need for a communication system that could keep pace with the requirements of the late 20th Century. It obviously generates sufficient profit to recoup investment, cover operating costs and finance expansion. However, since it is not a privately owned commercial operation, it does not have either to practice or display the more obsessive characteristics of such organizations. The fact that it is providing exactly the service that is required is implicit in its remarkable growth, as a result of which the system has to move to 900 MHz after 1985. This affords the opportunity for further improvements in certain performance characteristics, such as faster signaling, call set-up and hand-off procedures. The already superior frequency economy will be improved and sub-cell and cell-in-cell forms will be used to expand the system capacity whilst maintaining the proven NMT configuration.

Other efforts

Distinct from the Nordic PTTs, equipment suppliers to the system continue to spend huge sums on research and development. Typically, Mobira, Salo, Finland, has been involved since NMT was first con-

ceived and currently leads the market with about 19% of radiotelephone sales (Table 1). The company is also supplying quantities to the U.K. market. Ericsson, Stockholm, Sweden, holds a slightly smaller overall share but leads the market in Norway and Sweden, while Storno, Copenhagen, leads in Denmark. Total NMT sales in 1983 were 43,024 units.

Meanwhile, the Scandinavian PTTs continue to look ahead and have already formulated plans for a digital pan-European system for the 1990s. For this reason, it has been suggested that the present confusion and incompatibility within Europe may not be all that important. It was inevitable that either the U.K., France or Germany, or all three, would eventually have a deciding influence on the introduction of a European system. The French preference was for the drawing board ideal of the MATS-E system for which there is no product. West Germany wants the NETZ-E 450 MHz system, and the two of them look like agreeing eventually on a 900 MHz version of this.

Meanwhile the U.K. is going ahead with the TACS system, modified from the U.S. AMPS to such an extent that equipment is not interchangeable. Saudi Arabia and Korea have chosen NMT.

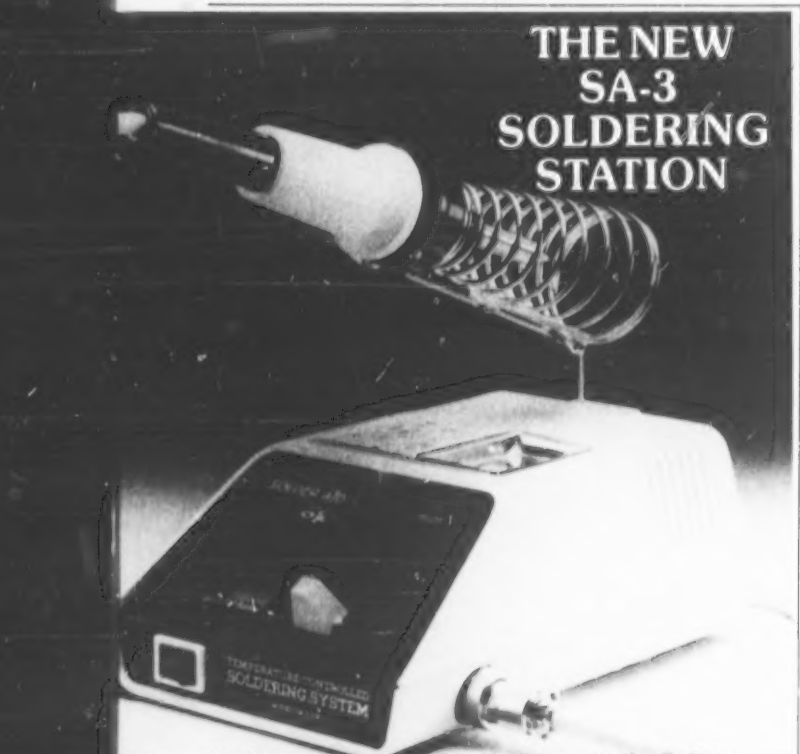
It seems that everyone now has an opportunity to go it alone and acquire useful operating experience before the dictates of the approaching 21st Century communication requirements eventually impose a unified international system or produces the technology which will marry any one system to another.

During this period, the NMT system will go to 900 MHz since the need is too pressing to wait for the experience of the only other current alternative—TACS. It is a sobering thought that even 16 years from now, market forces applying at the time may decide the 21st Century's system rather than experience and planned development. If there should still be a proliferation of systems, the quote of the millenium could well be: "Freedom of speech by all means—but this is ridiculous!" □

Table 1
Total sales and percentage of NMT radiotelephones

Brand	Finland	Norway	Sweden	Denmark
Mobira	3173 (54.2%)	1579 (12.7%)	2325 (14.5%)	1022 (11.7%)
Ericsson	619 (10.6%)	2100 (16.9%)	3479 (21.7%)	1327 (15.2%(
AP	577 (9.9%)	1788 (14.4%)	1331 (8.3%)	2060 (23.5%)
Siemens	370 (6.4%)	1800 (14.5%)	1571 (9.8%)	1459 (16.7%)
Panasonic	581 (10%)	1260 (10.2%)	2678 (16.7%)	17 (0.2%)
Storno	183 (3.1%)	907 (7.3%)	1267 (7.9%)	2130 (24.4%)
Motorola	114 (2%)	1428 (11.5%)	1443 (9%)	113 (1.3%)
NEC	171 (2.9%)	310 (2.5%)	1122 (7%)	480 (5.5%)
Mitsubishi	44 (0.8%)	559 (2.5%)	818 (5.1%)	52 (0.6%)
Simonsen	nil	683 (5.5%)	nil	nil
Dancall	nil	nil	nil	76 (0.8%)
Others	8 (0.1%)	nil	nil	nil
Total	**5840**	**12,414**	**16,034**	**8736**

(Source: Mobira News, May 1984 edition)



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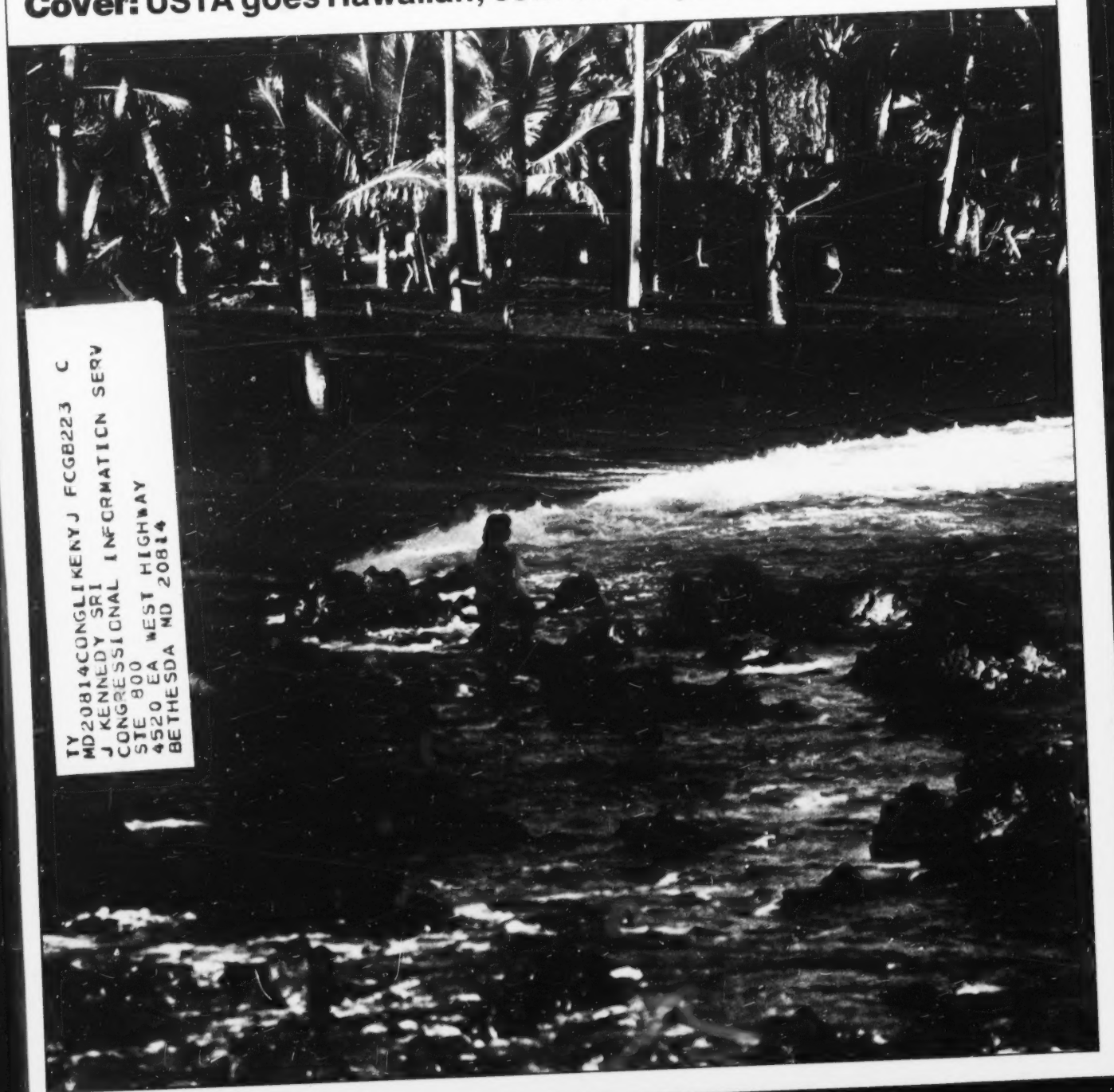

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Big spenders are spending more

NORMAN H. SEFTON and MARK V. MORAWIEC

AN INTERNATIONAL Communications Assn. (ICA) survey indicates a 13% annual increase in expenditures for telecommunications services as a percentage of sales and operating expenses.

An interesting trend has emerged regarding expenditures for telecommunications services according to the ICA survey. Other telecommunications associations also participated in the 1984 ICA survey, including the Southeastern Telecommunications Assn. (SETA), the Telecommunications Assn. (TCA), the Assn. of College and University Telecommunications Administrators (ACUTA), the Communications Managers Assn. (CMA) and the Chicago Industrial Communications Assn. (CMA).

In 1984 data was collected from 254 companies, universities, hospitals and government agencies; 23% of ICA's total membership was contacted. Data was combined into appropriate classes with an average of seven responses per category.

The survey requested information regarding sales, operating expenses and expenditures for telecommunications services. Tables 1 and 2, and Figures 1 and 2 present the results of the 1984 survey in addition to data obtained from a similar survey conducted by the ICA in 1981. The 1984 survey uses financial data from 1983 while the 1981 survey used 1980 data.

The computer services industry showed the telecommunications expense as the highest percentage of both sales and operating expenses with 6.64% and 7.19%, respectively. This is consistent with the 1981 survey, which also showed computer services greatly outdistancing its followers in both categories.

Many similarities exist between the results obtained this year and those from the 1981 survey. Dominating the next five rankings from each survey are office equipment/computers, electrical/electronics, airlines, and banks and bank holding companies.

Overall

An overall figure for telecommunications expense was calculated across all industries. This resulted in 0.74% of sales and 0.95% of operating expenses. Relating this to data from the 1981 survey shows a 45% and 46% increase in telecommunications expense as a percentage of sales and expenses, respectively. (The 1981 survey gave telecommunications expenses at 0.51% of sales and 0.65% of expenses.) This is an annualized 13.25% increase based on sales and 13.5% increase based on expenses. This demonstrates not only that companies are spending more money on telecommunications services, but this expense now is encompassing a higher percentage of their sales and operating expenses.

The surveys conducted 3 years apart illustrate two main points. First, there are several industries which continue to be the leaders in telecommunications expenditures in relation to their sales and operating expenses. Second, corporations, universities, hospitals and government collectively have demonstrated more than a 13% annual increase in the amount of money allocated to telecommunications as a percentage of their revenues and expenses. □

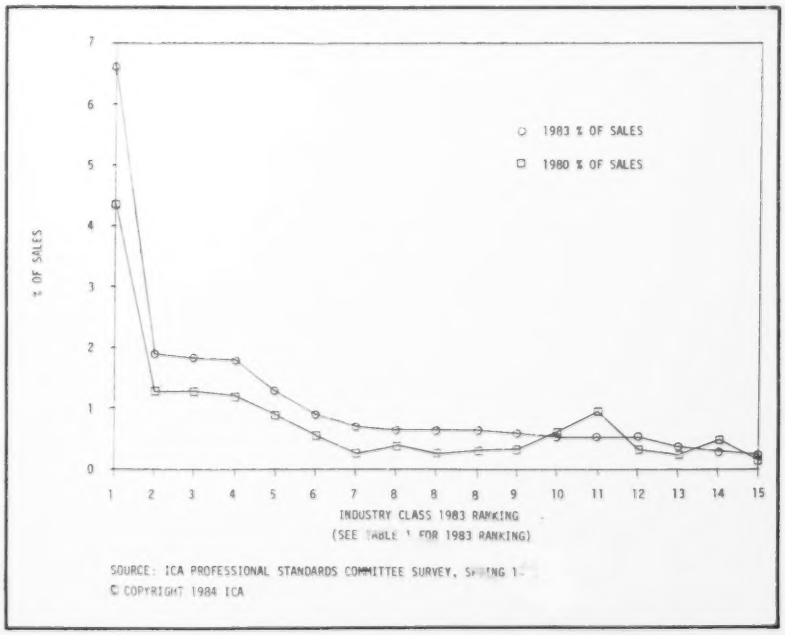
1983 % OF SALES
1980 % OF SALES
% OF SALES
INDUSTRY CLASS 1983 RANKING
(SEE TABLE 1 FOR 1983 RANKING)
SOURCE: ICA PROFESSIONAL STANDARDS COMMITTEE SURVEY, SPRING 1
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FIG. 1 *Telecommunications expense as a percentage of total corporate sales.*

Norman H. Sefton is Assistant Business Manager-Communications for Duke University, Durham, N.C., and a Board Member of the International Communications Assn. (ICA). *Mark V. Morawiec* is a Masters of Business Administration (MBA) Student at the Fuqua School of Business at Duke University. This article was adapted from one that appeared in the ICA Communique, August 1984, Vol. 38, No. 2. Copyright 1984, ICA. The ICA 1983 Telecommunications Expense Survey Final Report was prepared under the supervision of Norman Sefton with the assistance of the ICA Professional Standards Committee Members.

Table 1
Telecommunications expense % sales

1983 RANK	1980 RANK[1]	TYPE OF INDUSTRY	1983 % SALES	1980 % SALES
1	1	Computer Services	6.64	4.40
2	3	Office Equipment/Computers	1.89	1.30
3	3	Electrical/Electronics	1.84	1.30
4	4	Airlines	1.83	1.20
5	7	Transportation-Shipping & Rail	1.25	0.86
6	10	Conglomerates	0.85	0.58
7	23	Food Processing	0.70	0.25
8	13	Insurance	0.65	0.42
8	22	Metals/Mining/Steel	0.65	0.27
8	20	Textiles & Apparel	0.65	0.30
9	17	Manufacturing	0.62	0.36
10	9	Aerospace	0.57	0.61
11	6	Financial-Non Bank	0.56	0.98
12	19	Chemicals	0.55	0.34
13	21	Automotive	0.38	0.29
14	11	Utilities	0.34	0.53
15	24	Energy	0.23	0.18
		AVERAGE	1.19	0.83
		MEDIAN	0.65	0.58
		STD. DEVIATION	1.46	0.96

1. Ranking based on 26 categories appearing in 1980 survey results.

Source: ICA Professional Standards Committee Survey, Spring 1984.
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Table 2
Telecommunications expense % expenses

1983 RANK	1980 RANK[1]	TYPE OF INDUSTRY	1983 % EXPENSES	1980 % EXPENSES
1	1	Computer Services	7.19	6.20
2	*	Service Organizations	3.35	*
3	4	Banks & Bank Holding Companies	2.08	2.10
4	7	Office Equipment/Computers	1.98	1.60
5	6	Electrical/Electronics	1.97	1.70
6	8	Airlines	1.87	1.20
7	14	Conglomerates	1.47	0.66
8	9	Transportation-Shipping & Rail	1.39	0.96
9	8	Universities	1.27	1.20
10	*	Hospitals	1.16	*
11	23	Textiles & Apparel	0.96	0.35
12	13	Insurance	0.92	0.73
13	21	Food Processing	0.87	0.42
14	15	Government	0.80	0.64
14	16	Manufacturing	0.80	0.60
15	17	Metals/Mining/Steel	0.65	0.52
16	8	Financial-Non Bank	0.62	1.20
17	15	Aerospace	0.61	0.64
18	22	Chemicals	0.59	0.40
19	24	Automotive	0.52	0.30
20	11	Utilities	0.38	0.80
21	25	Energy	0.24	0.24
		AVERAGE	1.36	1.12
		MEDIAN	0.92	0.73
		STD. DEVIATION	1.45	1.26

1. Ranking based on 30 categories appearing in 1980 survey results.
*No data in survey.

Source: ICA Professional Standards Committee Survey, Spring 1984
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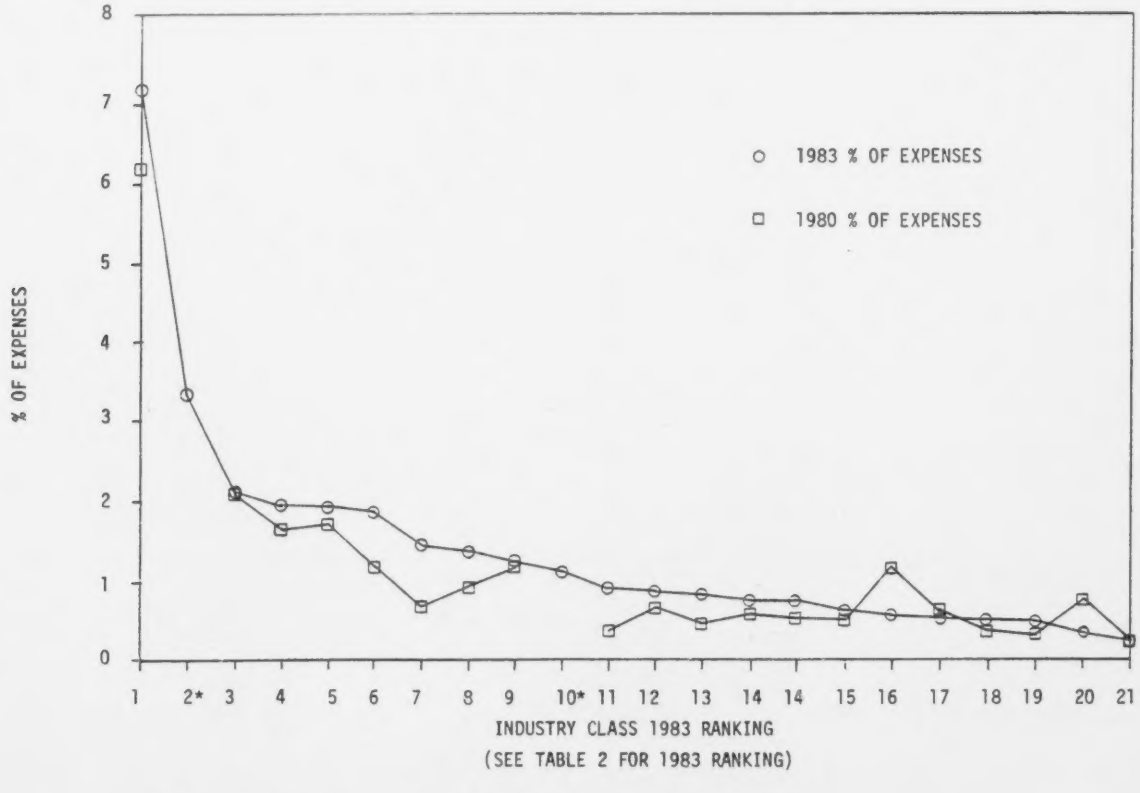
FIG. 2 *Telecommunications expense as a percentage of total corporate expenses.*



SOURCE: ICA PROFESSIONAL STANDARDS COMMITTEE SURVEY, SPRING 1984
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